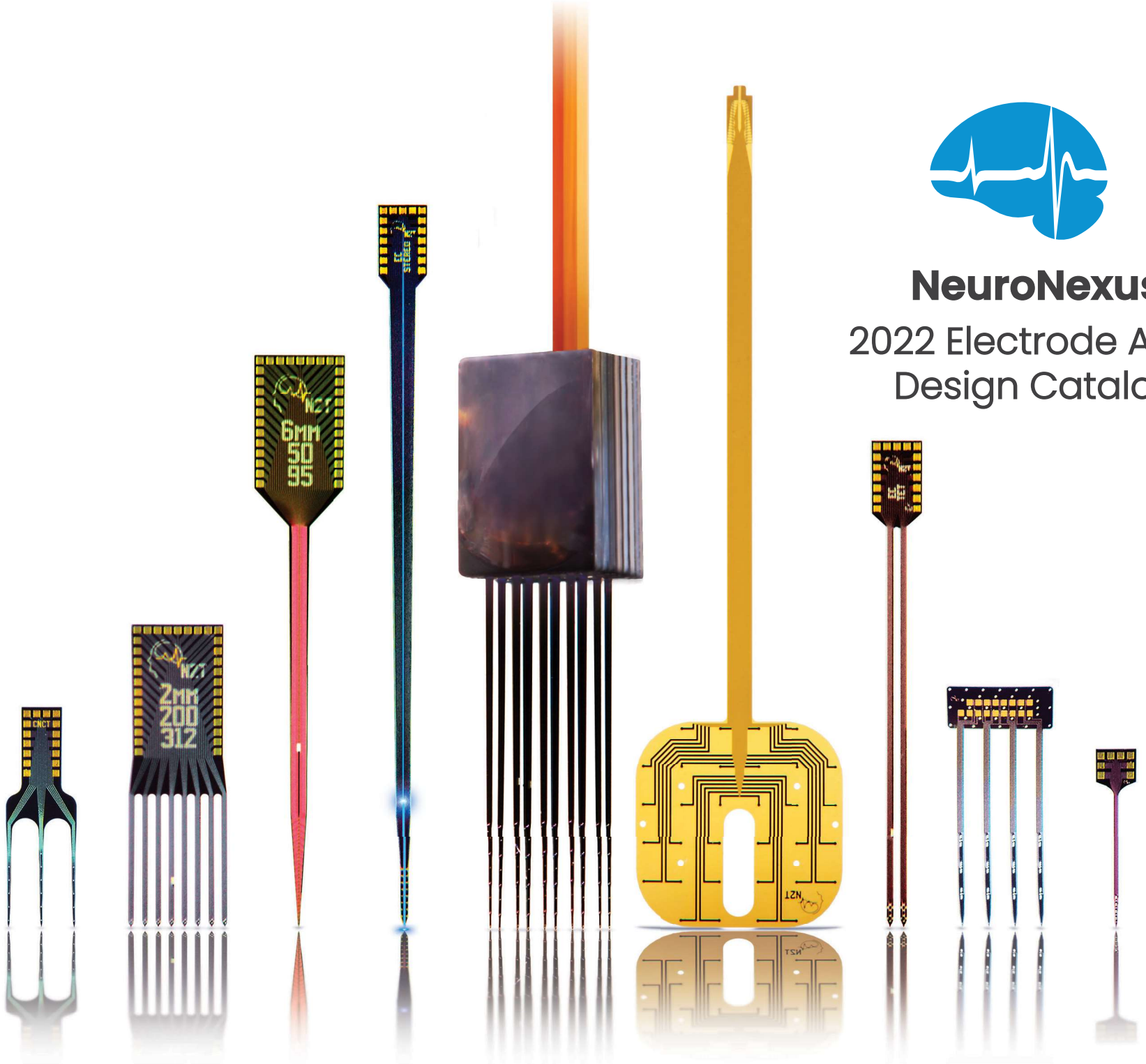

NeuroNexus

2022 Electrode Array Design Catalog

Welcome!

Life science research encompasses a broad range of applications that are as unique as the labs performing them. Through a well-defined consultative process, NeuroNexus assures the best tool selection before each experiment and delivers unmatched support during and after the experiment to enable researchers to feel confident in reliable data from start to finish. Our focus and passion are to create high-performance interfaces to precisely targeted circuits in the central, autonomic, and peripheral nervous systems and end organs such as the heard; and our technologies and solutions extend from the tissue interface to the user interface. Our devices, systems, and software are professionally engineered and manufactured so that we can provide high-quality and reliable solutions as we partner with our customers to take their scientific research to the next level. Visit neuronexus.com to view our entire line of products and services.

Thank you for your interest in NeuroNexus.

We pride ourselves on working at the forefront of neural interface technologies and neuro-analytics to develop innovative products that both empower life science research and accelerate translation to next-generation clinical therapies. Put simply, we eat, breathe, and live microelectrode arrays, instrumentation, algorithms, analytics, and manufacturing 24/7 to provide professional tools and solutions so that researchers can focus on their science.

As the world emerges from the Covid-19 pandemic, we are pleased to announce many new and updated products and services to help the life science community return to normality. Our engineers, scientists, and manufacturing specialists spent the Covid period innovating and improving our product development and manufacturing processes. Our flagship silicon microelectrode arrays have been refreshed from top to bottom, our Smartbox Pro instrumentation system has gained features and performance. And, as part of a major new initiative, we are launching the NeuroNexus Radiens neuro-analytics software system, a highly innovative, high-performance software platform designed from the ground up to increase the pace, quality and impact of increasingly complex neuroscience and life science research.

I invite you to browse our catalog and website and to contact us directly to discuss ideas, needs, and opportunities. Enjoy!

Daryl Kipke, PhD
Founder, Managing Director, and CEO
NeuroNexus Inc. and The NEL Group Inc.

Version 2022.01

March 24, 2022

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Editor's Note: *NeuroNexus is constantly growing and adapting our product lines to meet the needs of researchers and scientists. To stay informed of our latest developments, please visit neuronexus.com and download the latest catalogs, brochures, and technical documents.*

1 Systems and Software

SmartBox Pro

DATA ACQUISITION AND EXPERIMENT MANAGEMENT / PROBE CONDITIONING

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The **SmartBox Pro** is a high-performance, multi-functional instrument used for signal acquisition, experiment control, and probe diagnostics. The SmartBox Pro is plug-and-play compatible with all NeuroNexus probes – an important time-saving feature as probes become more complex, and channel counts increase. This integration between the SmartBox Pro and NeuroNexus probes means we can provide a fully configured system with high-end performance and features at a comparatively low price.

The SmartBox Pro runs on the Radiens Analytics™ software suite.

SPECIFICATIONS

Acquisition Channel Count	Up to 1024
A/D Resolution	16-bit, 0.15µV
Sampling Rates	1 kS/s - 30 kS/s per channel
Peripheral Output	2 Analog, BNC (± 3.3 V) 2 Digital, BNC (0 - 5 V TTL)
Peripheral Input	2 Analog, BNC (± 5 V) 2 Digital, BNC (0-5 V TTL)
Audio Monitoring	1 stereo line out (3.5 mm), user selectable
Cutoff Frequency	Adjustable; Lower: 0.1 - 500 Hz, Upper: 100 Hz - 20 kHz2.4
Low Input-referred Noise	2.4 µVrms typical
Input/Output Range	± 9 V, ± 25 mA
Smallest Detectable Signal	≈ 15 µV

Radiens™ Analytics Software Suite

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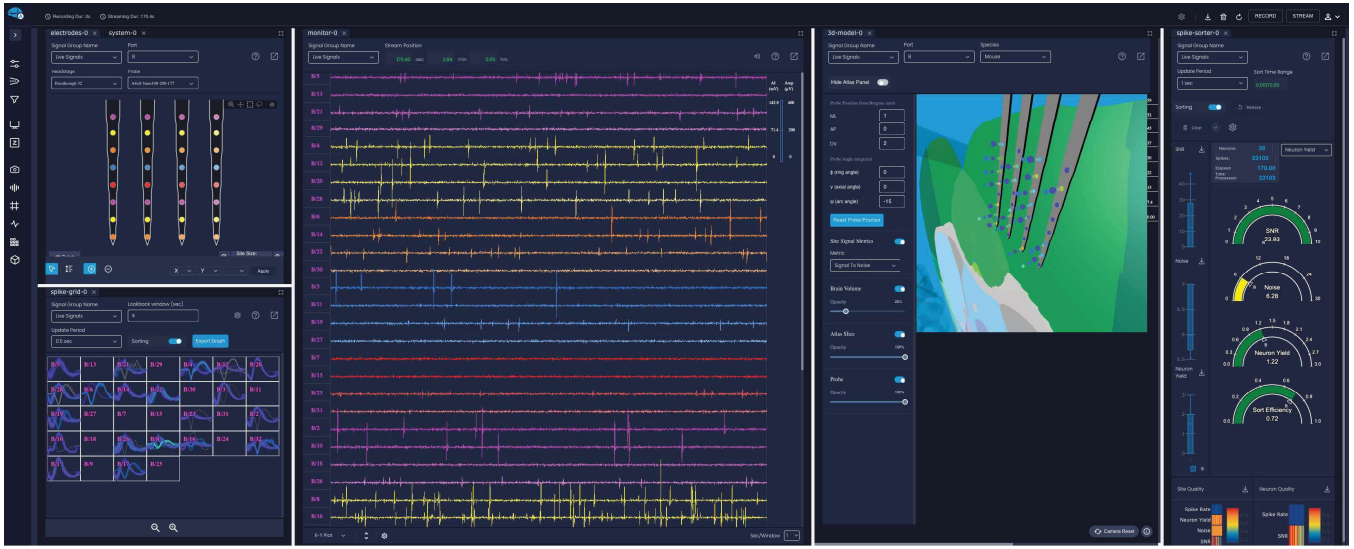


The Radiens™ suite consists of three well-integrated applications:

- Allego
- Curate
- Videre

Radiens™ is software written by neuroscientists for neuroscientists to provide a superior toolset for electrophysiological applications. The Radiens™ environment provides full laboratory management through creating unique logins and event tracking for all your experiments, managing probe inventory, and assuring data security and completeness. Remote logins also allow offsite observation during experiments.

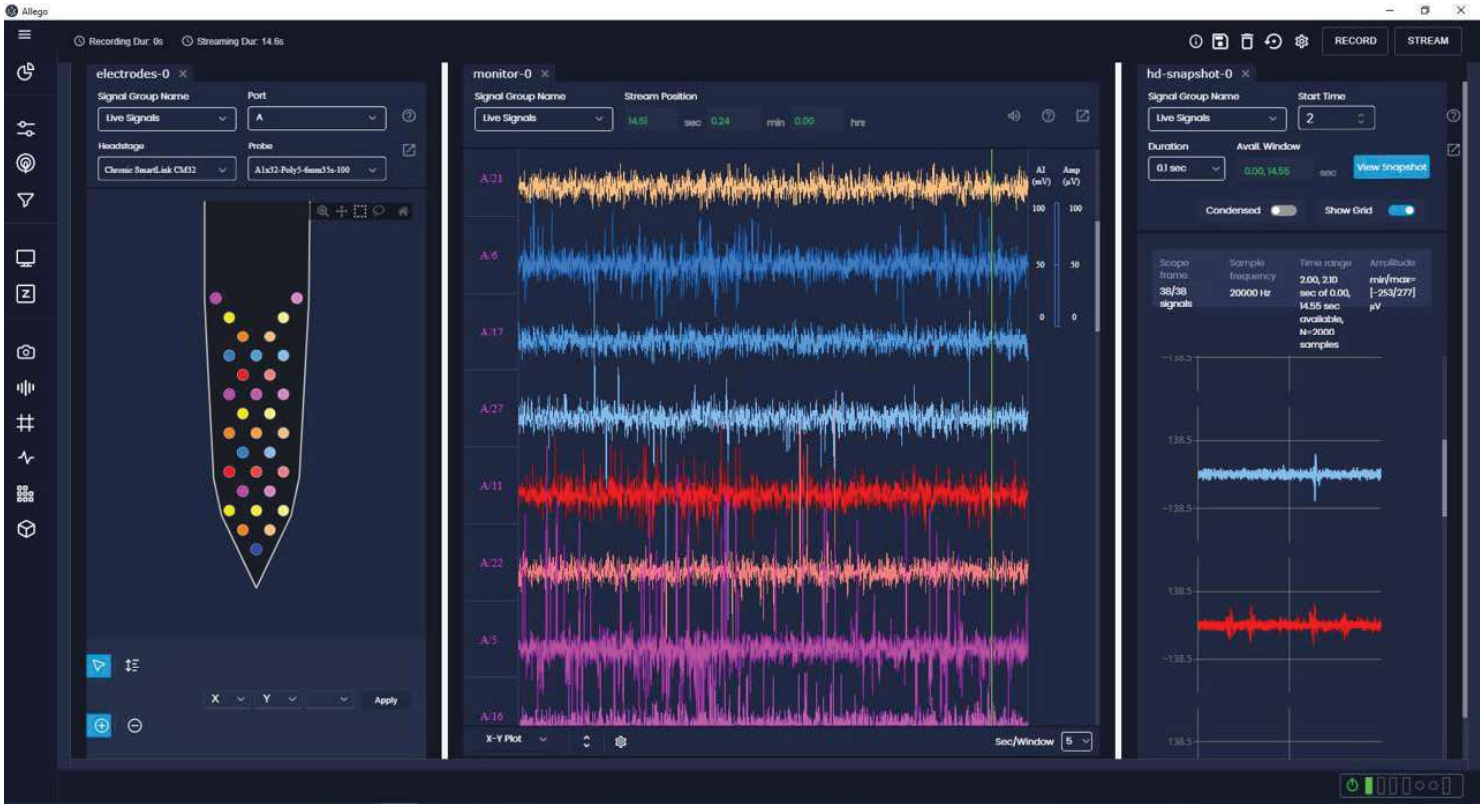
The validated probe-centric approach helps to detect patterns within data as it is being recorded and enables quick verification of results. Built-in 3D brain models validate probe location, neuronal populations, and neural network activity both in real time and in file playback.

The file-based functional interface twin within Radiens™ enables mapping of neural, cardiac, and muscle activity while viewing the spatial relationship between the recording sites on any NeuroNexus probe. This software accelerates neuroscience research through its unique combination of performance, ease of use, and forward-looking advanced features.

ALLEGO

Allego is an advanced real-time signal processing software with plug-and play compatibility with a variety of data acquisition systems.

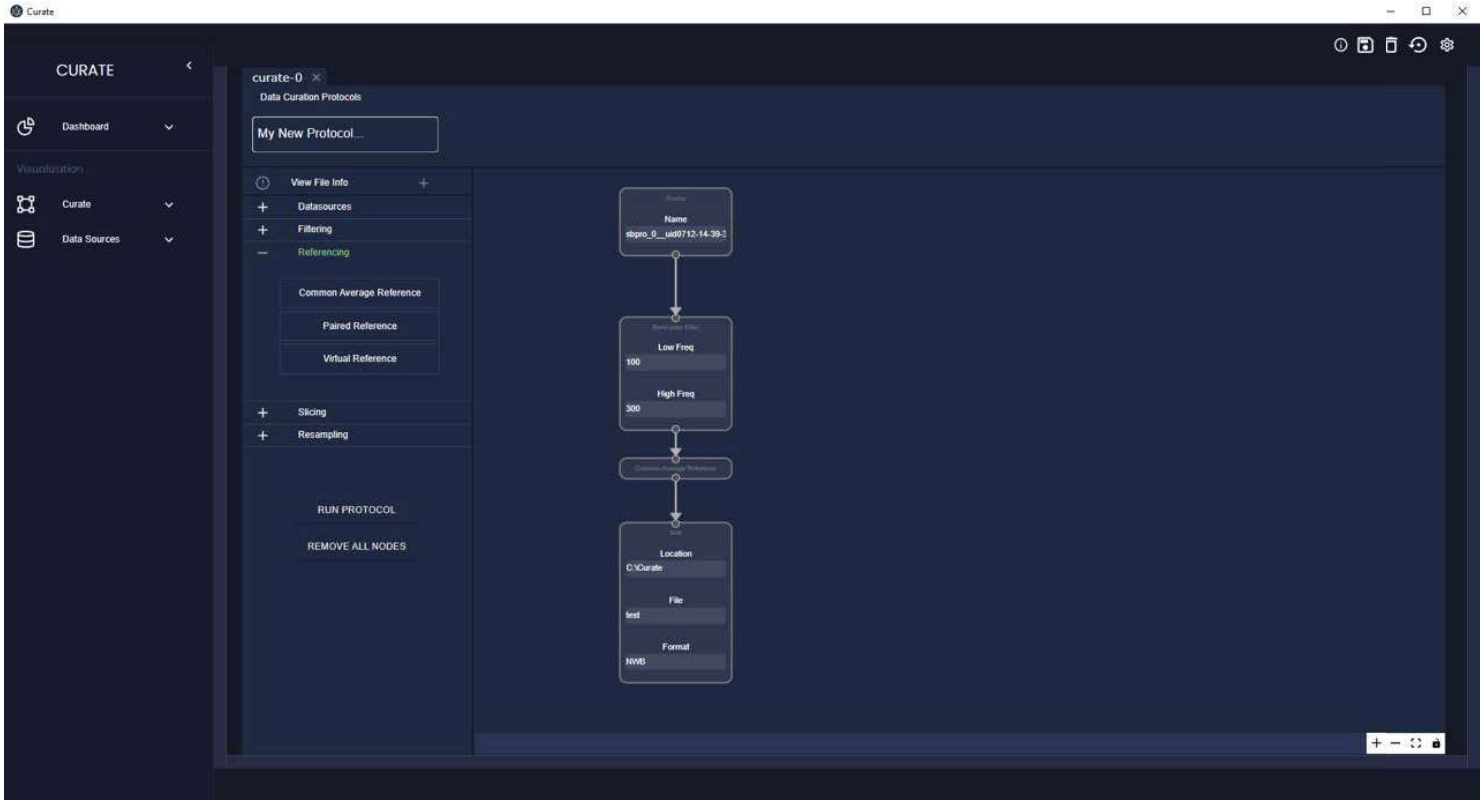
- **Powerful** – Record up to 1024 channels simultaneously at a sample rate of 30 kHz
- **Portable** – Take your recording system and laptop with you and record from anywhere
- **Connect to peripherals** – A total of 8 I/O connections (4 analog, 4 digital) enable signal synchronization with digital and analog peripherals
- **Probe-centric** – Innovative interface provides instant and precise spatio-temporal relationships among signals – an important feature as probes become more complex
- **Ready to go** – USB 3.0 plug-and-play with Windows, Mac, and Linux



CURATE

Curate is an a data processing manager for data integrity and curation of electrophysiological data sets using customizable batch processing protocols

- **Curate** offers easily accessible, large-scale data management, along with an infrastructure for reproducible signal processing and batch processing through modular pipelines.
- **Flexible Post-processing:** Raw data is streamed to disk for maximum options in post-processing. Read data into MATLAB or export to other programs for analysis.
- **Curate** enables extracting, structuring, and managing recorded electrophysiological data files while maintaining descriptive metadata. Together with the full Radiens™ Analytics suite, this software accelerates reproducible and transparent neuroscience research.



VIDERE

Videre is a highly integrated and intuitive software for electrophysiological data processing and analysis of multiple data types and formats.

- **Import and review** data files with the ability to explore the functional interface as if you're back in the experiment room.
- **Work through data -** Useful for labs sitting on backlogs of data recorded with NeuroNexus probes. Your NeuroNexus Application Scientist can help you translate any file type into the software.
- **Videre** includes probe geometry data, signal metrics from the experiment, spike sorting, and a twin of the functional interface visualized in 3D spatial models of the brain.

SmartLink Headstages

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SmartLink headstages connect conventional high impedance probes (such as NeuroNexus Standard Probes) to the SmartBox system.

- **Reduced noise and motion artifact** – Because signal digitization occurs right at the implant location, SmartLink headstages allow probes to perform better in the noisy environments typically found in surgical suites.
- **Options** – SmartLink headstages are available in 16, 32, and 64 channel options, each with acute and chronic variants.

SPECIFICATIONS

A/D Resolution	16-bit, 0.15 µV
Sampling Rates	1 kS/s - 30 kS/s per channel
Cutoff Frequency	Adjustable; Lower: 0.1 - 500 Hz, Upper: 100 Hz - 20 kHz
Low Input-referred Noise	2.4 µVrms typical
Input Range	± 5 mV
Smallest Detectable Signal	≈ 15 µV
Amplifier Differential Gain	192 V/V (45.7 dB)
Amplifier DC Differential Gain	0 (Complete DC rejection)
Amplifier Input Impedance	1300 MΩ at f = 10 Hz 13 MΩ at f = 1,000 Hz

2

Targets up to 10mm deep

The NeuroNexus Probe

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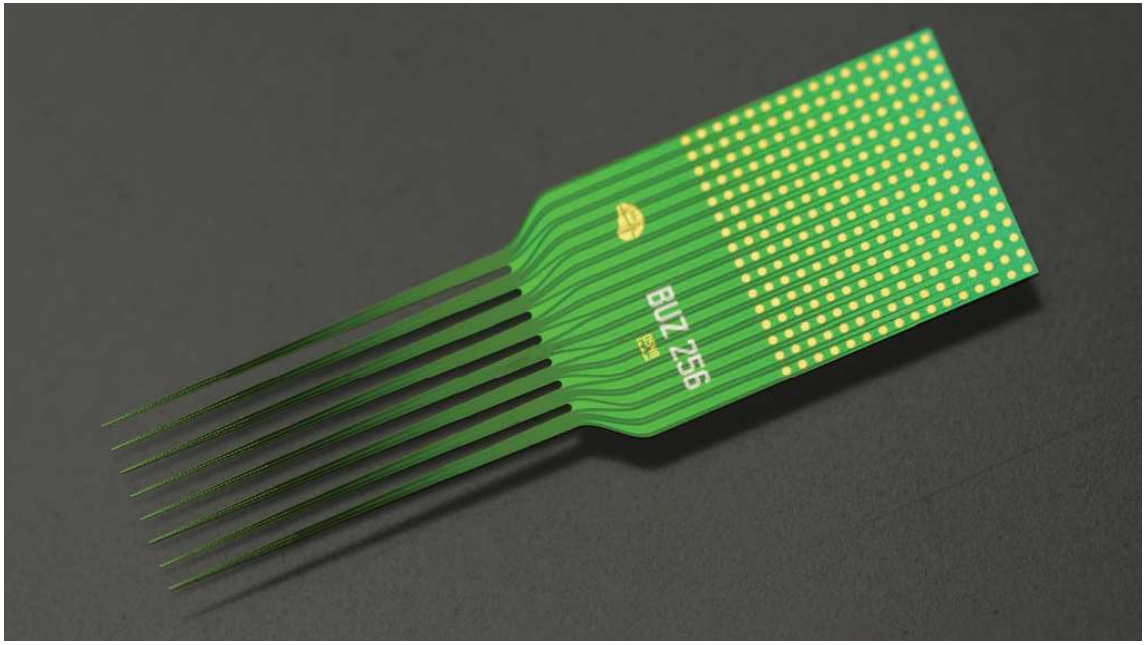


NeuroNexus **Standard Probes** are fabricated using state-of-the-art silicon MEMs technology. Standard Probes are used in labs worldwide for single unit, multiple unit, and local field potential (LFP) recording and stimulation, in acute and chronic applications.

- **Consistent results** – NeuroNexus probes are produced with reliable mechanical, geometric, and electrical characteristics. This means fewer variables for you to manage.
- **A Toolbox of Designs** – We offer a huge variety of electrode array designs for different applications, brain structures, and animal models. Combined with our vast packaging options, you are sure to find a probe to suit your needs – and if not, we can design a probe that will.
- **Acute and Chronic** – Standard Probes can be used successfully in both acute and chronic applications.
- **Connect to any system** – Each microelectrode array is matched with a connector package to connect to a headstage. NeuroNexus collaborates with system manufacturers to ensure our probes connect seamlessly.

SPECIFICATIONS

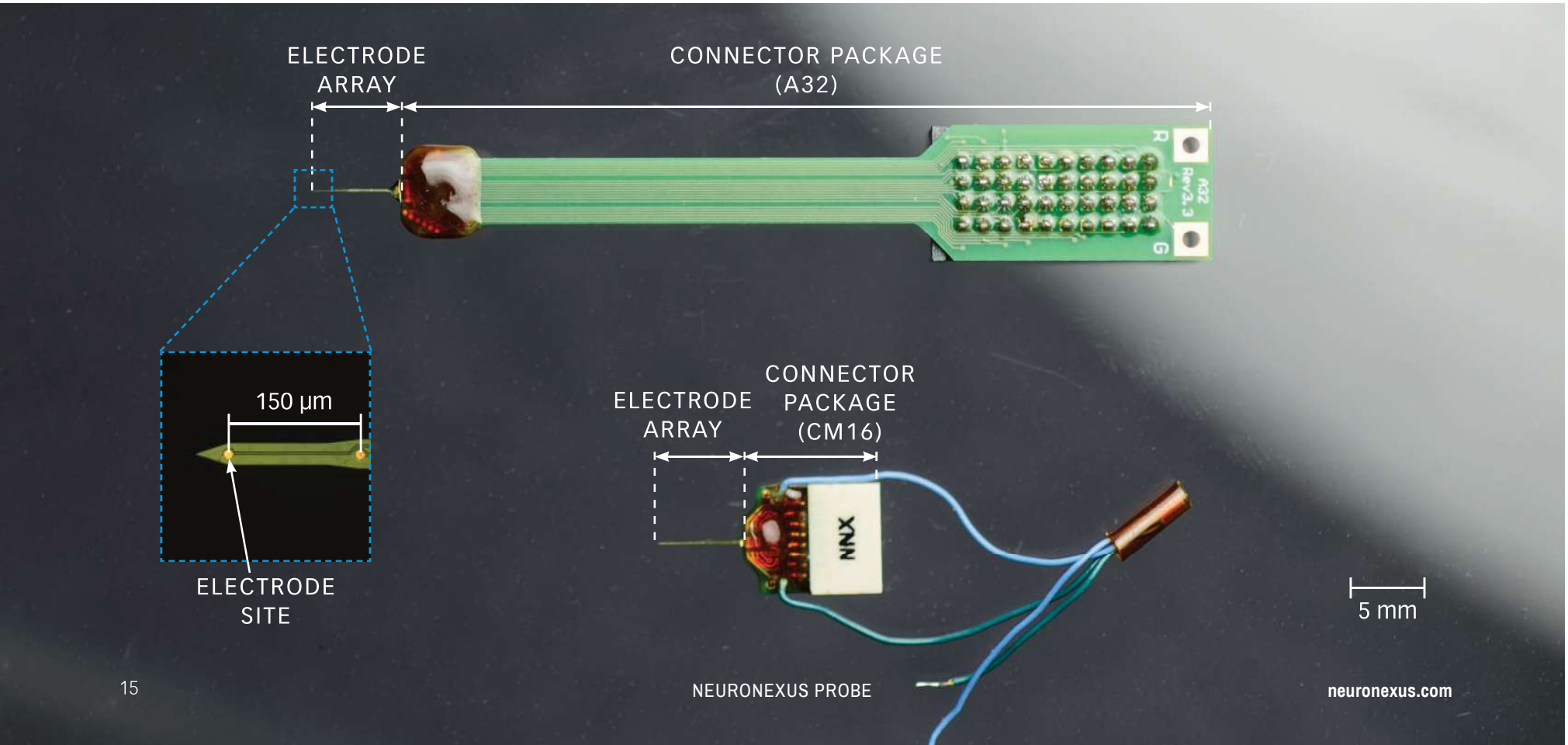
Usage	Single unit, Multiple unit, LFP. Record and stimulate. Acute and chronic.
Electrode Site Material	Iridium (standard), Platinum (custom), Gold (custom)
Electrode Thickness	15 µm or 50 µm (varies by design)
Electrode Length	2 - 15 mm (varies by design)
Channel Count	16, 32, 64, 128, 256 (varies by design)

Neural Probes: In Detail

NeuroNexus products are at the forefront of neural interface technology. Our meticulously crafted neural probes can be broken down into two parts: the **electrode array** and the **connector package.**

The **electrode array** interfaces with neural tissue by recording brain activity or delivering stimuli through precisely placed electrode sites. NeuroNexus probes are suitable for implanting into cortex or deep structures, as well as for interfacing with the brain or nerve surface.

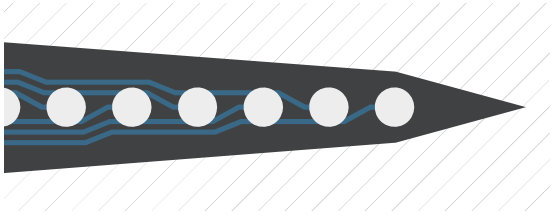
The **connector package** provides the interface between the electrode array and the external instrumentation. Each package includes a specific **connector** type. The same electrode array can be paired with different connector packages, giving you a high degree of flexibility in configuring the best neural probe to suit your experimental requirements.



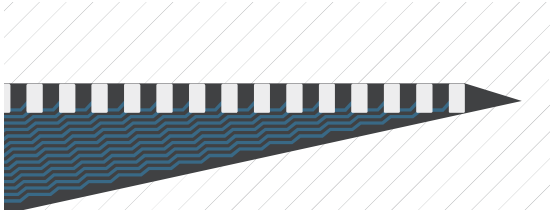
NEURONEXUS PROBE

STANDARD ARRAY SITE LAYOUTS

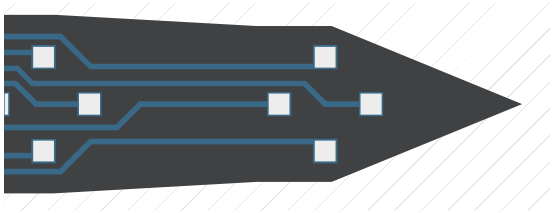
Below are examples of the different types of electrode array tips you can find in our **A-Style Probe Designs section, pgs. 23-77.**.



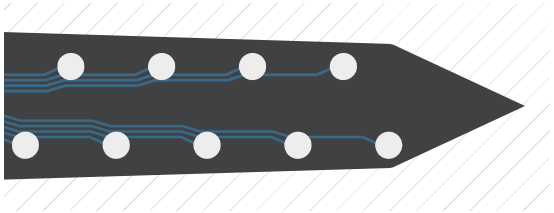
Linear electrode arrays are the foundation for multi-channel recordings. The laminar design allows for a longer area of coverage than a single tip site, and either facilitates or replaces the need for passage-type experiments. Linear electrode arrays fit the widest range of applications.



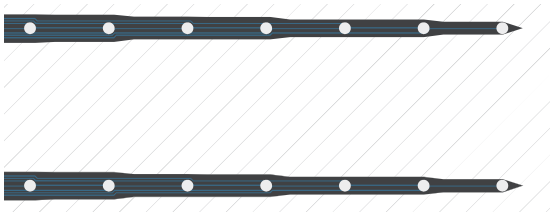
Edge sites are similar to the Linear layout, but electrode sites are strategically positioned at the edge of the substrate.



A **Tetrode** is an arrangement of four electrode sites placed close together, allowing for high-quality cell discrimination in recordings.



Polytrode electrode site layouts come in two variations: Poly2 (two columns of sites, shown left), or Poly3 (three columns of sites). They have a mix of linear and tetrode benefits, with sites close enough together to allow a degree of multiple representation across different sites, while sampling a larger space.



Multi-shank electrode arrays provide a two-dimensional representation of the brain. By controlling shank and site spacing, a more detailed understanding can be obtained of a larger space in the brain. Some multi-shank designs incorporate tetrode and polytrode site arrangements.

"Since NeuroNexus began fabricating probes with high reliability and reasonable costs, we virtually stopped using wire electrodes and monitor electrical activity with silicon probes. It is a one-way process: once one begins to record with silicon probes, he/she never goes back to wires."
- Dr. György Buzsáki, *New York University*

CUSTOM DESIGN

In certain research scenarios, a unique probe design may be required.

To help researchers achieve their goals, NeuroNexus offers a custom probe design service that provides unique access to a virtually unlimited design space. Almost any feature of a probe can be tailored to suit your application - and all it takes to get started is a sketch.

Each custom probe includes:

- Consultation with our engineering team to validate feasibility of your proposed design
- Translation of your design into a CAD layout
- Formal design review with our technical team
- State-of-the-art microfabrication of your design
- Packaging and testing of the fabricated probes

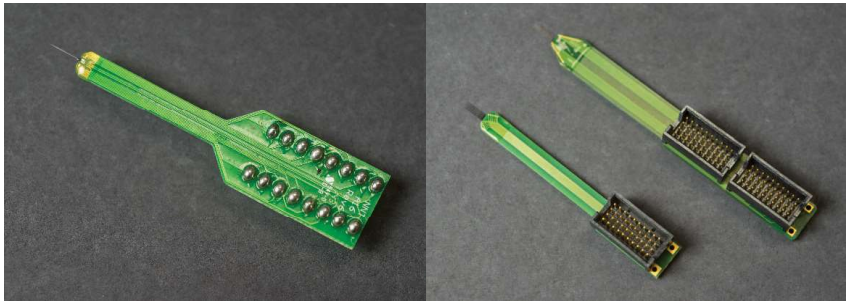
CONNECTOR PACKAGE AND HEADSTAGE INTERFACE

Standard probes can interface with almost any commercially available headstage via the **connector package,** which consists of a specialized circuit board and your choice of connector.

To configure a probe, you must select an appropriate electrode array for your experiment, and combine it with a package that matches your headstage/data acquisition system.

Packages can be classified as acute or chronic, though it is best to consider your existing data acquisition systems and experiment/animal model type. Below is a list of our most commonly requested connector packages - a full list of available packages (with specifications) can be found in the Package Specifications section of this catalog.

ACUTE



LEFT: A16 Package
RIGHT: A32 (left) and A64 (right) Packages

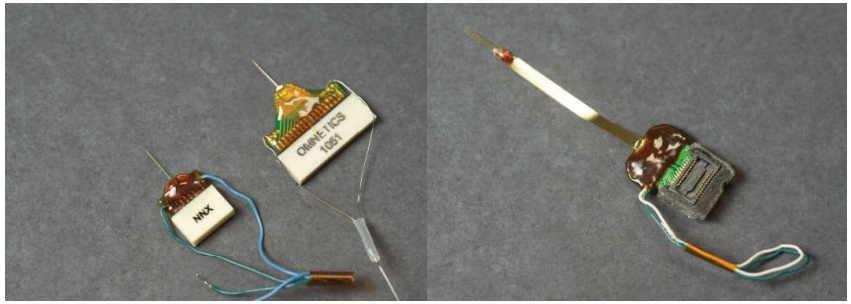
The A-Series package is suitable for acute experiments. The package is easy to handle and can be used with standard stereotactic frames.

Available acute packages:

- A16 / A32 / A64

**Note chronic packages may also be used acutely. Both options use the same proven silicon probe technology.*

CHRONIC



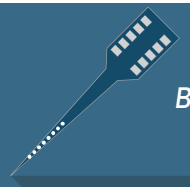
LEFT: CM16LP (left) and CM32 (right) Packages
RIGHT: HZ32 Package

Multiple packages can be specified for chronic experiments. The CM-Series is small and lightweight, permitting chronic implantation in mice. The H-Series packages include a robust, flexible cable, enabling microdrive use or floating implants. The Z-Series utilizes TDT's patented Zif Clip™ technology.

Available chronic packages:

- CM16LP / CM32
- H16 / HC16 / HZ16 / H32 / HC32 / HZ32 / H64 / H64LP / HC64 / HZ64
- Z16 / Z32 / Z64

How to Configure a Neural Probe



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A complete NeuroNexus neural probe assembly consists of two parts: an electrode array, and a package. Both must be configured.

Step 1:

Browse the catalog to find an electrode array that meets your needs. The Electrode arrays are grouped first by **type** (A, E, V, etc.), then by **channel count,** and finally by **length.**

Step 2:

Determine the connector on your headstage, and find a package that will connect to it. The appendix details available packages.

EXAMPLE 1:

A user specifies an A1x32-6mm-50-177 electrode array. The lab uses a Plexon HST/16V-G20 headstage, which has an 18-pin Omnetics Nano strip connector. The user can specify either a CM16LP or an H16 package, both of which have 18-pin Omnetics Nano strip connectors. The user desires connector standoff from the implant site, so the H16 package is selected. Because the A1x32-6mm-50-177 electrode comes in two thicknesses, that must be specified as well.

This is the resulting part number for this probe:

A1x32-6mm-50-177-H16-50

Electrode Array — Package — Thickness

EXAMPLE 2:

A user wants to combine optical stimulation with neuronal recording using an A4x4-3mm-100-125-703 electrode array. The lab uses a TDT recording system with a 16 channel Zif Clip™ headstage. Because the user wants to specify an optoelectrode, the OZ16 package is selected. Because the electrode array has multiple shanks, the user must co-ordinate fiber placement with the sales co-ordinator. Because the A4x4-3mm-100-125-703 electrode only comes in one thickness, that value can be omitted from the part number.

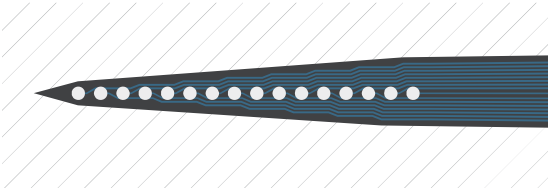
This is the resulting part number for this probe:

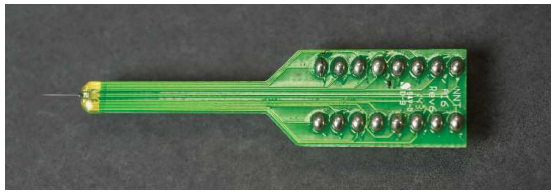
A4x4-3mm-125-703-OZ16

Electrode Array — Package

EXAMPLE CONFIGURATIONS

A1x16-5mm-25-177-A16

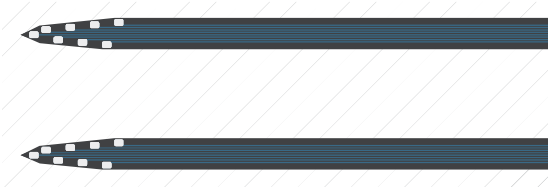


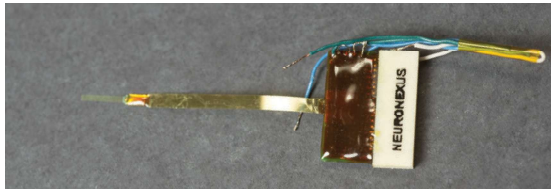


This example shows an A1x16-5mm-25-177 linear electrode array configured with an A16 connector package. The electrode is 5mm long, and electrode site coverage spans 375 µm.

The A16 package utilizes Dual Inline Pin connections. Because of its size, this connector package is best suited for acute applications.

Buzsaki64-H64LP





This example shows a Buzsaki64 electrode array configured with a H64LP connector package. The Buzsaki64 electrode array has a unique “octrode” electrode site layout which spans 140 µm vertically and 1400 µm horizontally.

The H64LP connector package utilizes two 32-channel Omnetics Nano connectors and includes a 30mm flex cable for connector standoff.

NEURONEXUS CAN HELP

If you are not sure what electrode array or package you need for your experiment, please contact us for assistance.

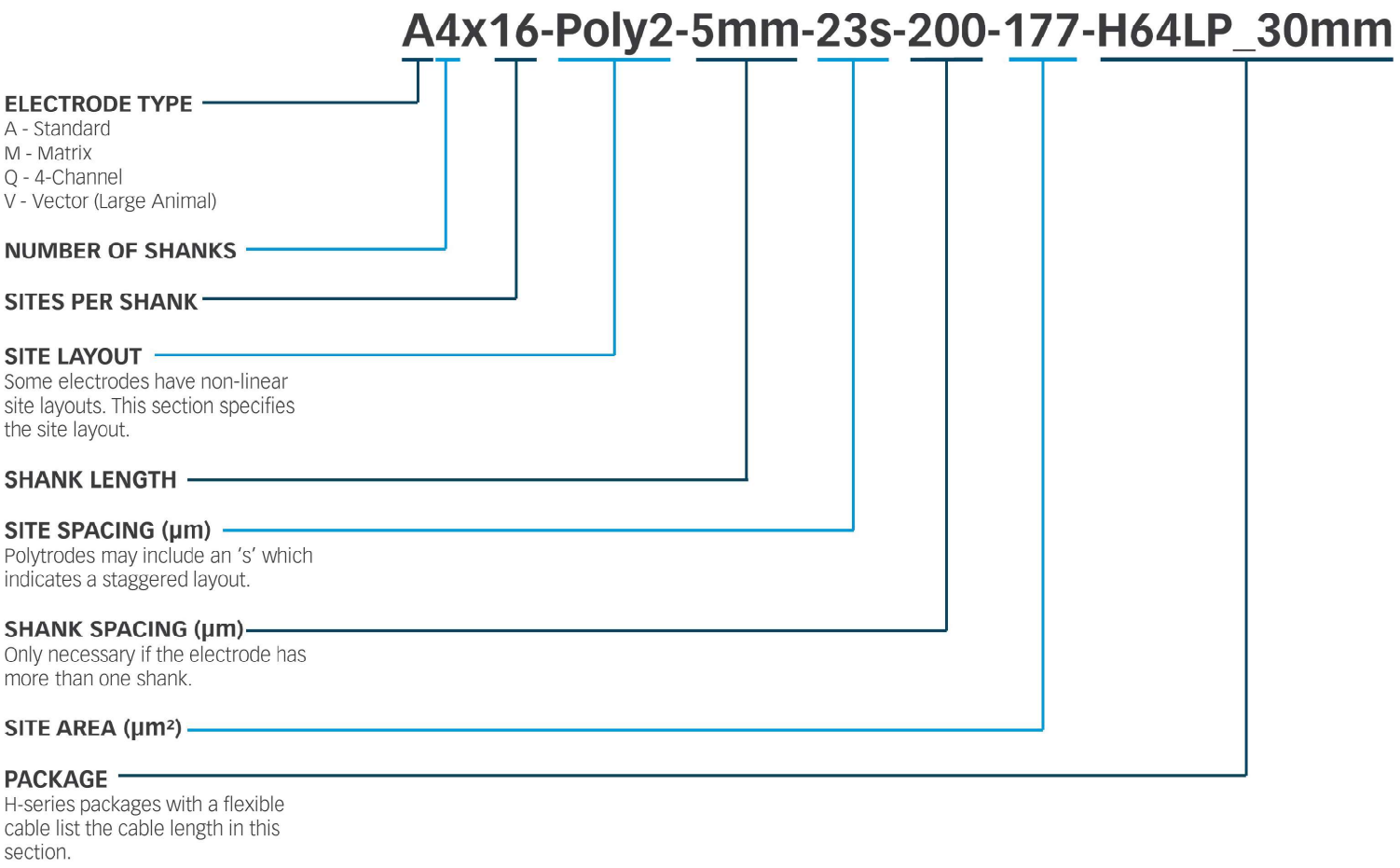
NeuroNexus staff have decades of combined experience in neuroscience and neural engineering. Additionally, we may be able to direct you to other researchers in hundreds of labs all over the world who have found success using NeuroNexus products.

To contact us, please email **support@neuronexus.com**, or call +1.734.913.8858.

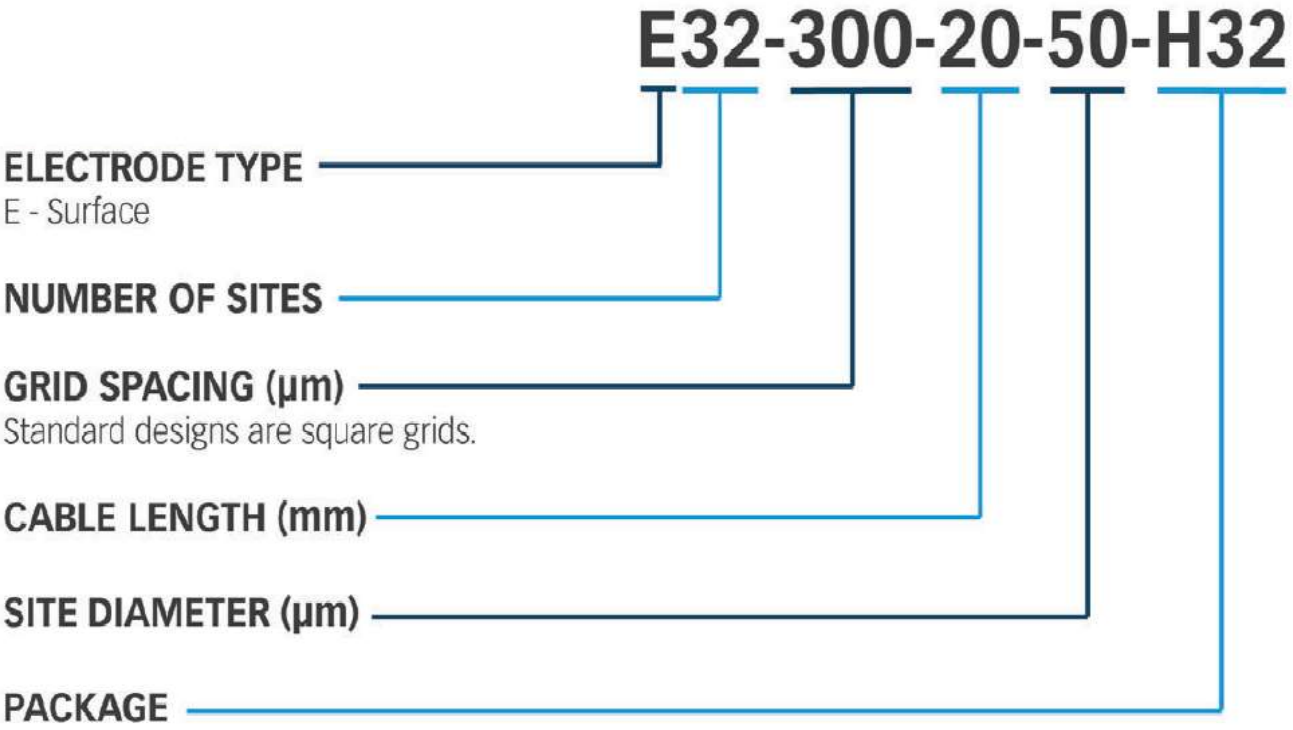
Our office hours are 8am - 5pm (Eastern Time Zone), Monday - Friday.

Model Numbers Explained

Penetrating Arrays



Surface Arrays



Activus-NNx Probes

SILICON PROBE TECHNOLOGY / HIGH CHANNEL PROBES

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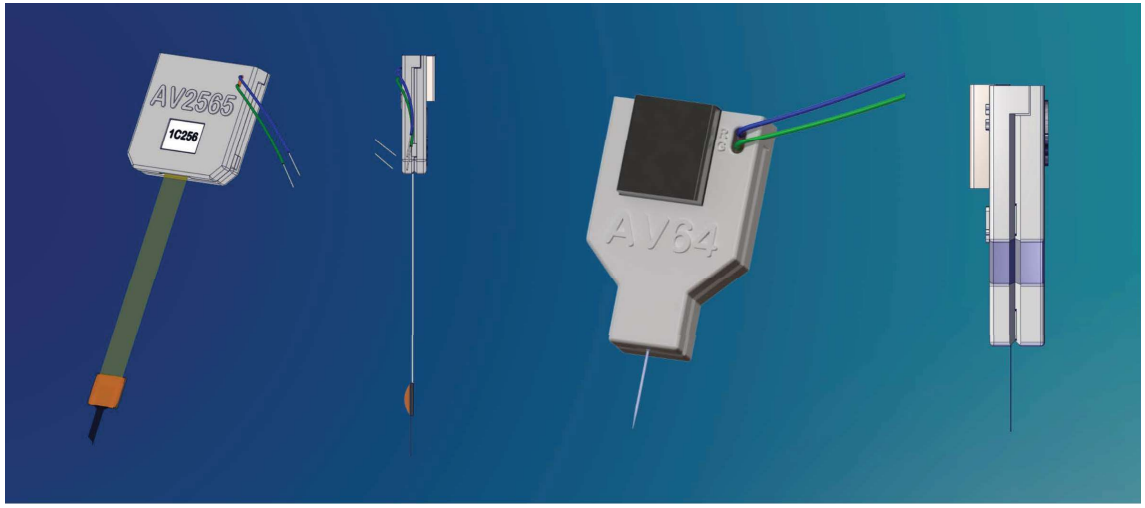

- **Eliminate adaptor and headstage connections** - Direct SmartLink µHDMI or Intan SPI connection reduces noise.

- **System Requirements: (Need 1 of 3)**
  - Smartbox Pro + Radiens Analytics Software Suite,
  - Open-ephys DAQ System, or
  - Intan DAQ System

Activus probes combine NeuroNexus flagship silicon probe technology and our full catalog of 64- and 128- and 256-channel designs with integrated electronics for onboard digitization. **Activus** probes allow users to scale up channel count with the added bonus of better signal-to-noise ratio. For versatility, the overall size and weight of **Activus** probe packages are still small enough for use with head-mounted mouse experimental models.

Advantages:

- Virtually unlimited design space
- Ultra-compact package
- Compatible with existing *and* customized probe designs
- Improved signal-to-noise ratio (SNR)
- Multiplexed signals reduce connector size
- Digitization close to signal source – leads to added protection against unwanted noise artifacts

Probe Options

Channel Count	64, 128, 256
A/D Converter	16-bit ADC
Sampling Rate	Up to 30 kSamples/s
Signal Bandwidth	0.1-100 Hz, 0.25 - 7.5 kHz
Electrode Array Length	1.5-15 mm
Electrode Array Thickness	15 µm or 50 µm (varies by design)
Electrode Site Material	Standard: Iridium Custom: Platinum, Gold
Available Packages:	AV64, AVH64, AVI64, AVIH64, AV128, AVH128, AVI128, AVIH128, AV256, AVH256, AVI256, AVIH256

Activus-SiNAPS Probes

ACTIVE HIGH CHANNEL COUNT PROBES

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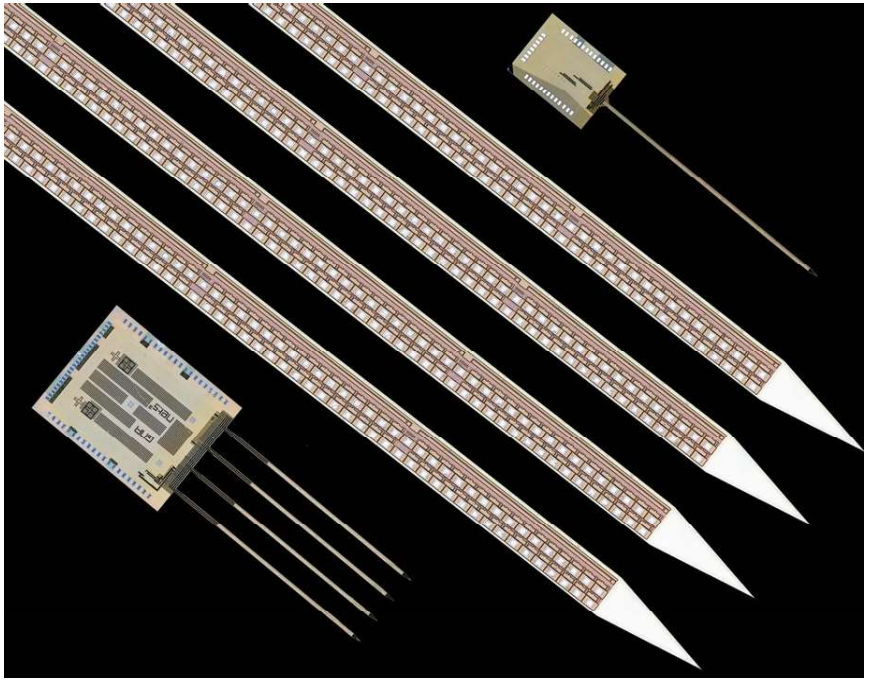

NeuroNexus has partnered with Corticale to help make this advanced probe technology available to researchers around the world.

SiNAPS products utilize a new probe technology with active CMOS circuitry integrated onto the probe. **SiNAPS** technology is an innovative advancement in multi-electrode solutions for in vivo electrophysiological studies on central and peripheral nervous system. This technology implements the Active Pixel Sensor (APS) concept in which active circuits for signal amplification, low-pass filtering, and multiplexing read-out are located directly underneath each electrode-pixel.

SPECIFICATIONS

Channel Count	256, 512, 1024
in-pixel Amplifier	46dB (DC-4kHz)
Sampling Rate	25 kSamples/s
Electrode Array Length	5.5-11 mm (varies by deisgn)
Electrode Array Thickness	40 µm
Electrode Site Material	Platinum
Available Packages:	AVS256, AVSH256, AVS512, AVSH512, AVS1024, AVSH1024

Advantages:

- High number of electrode sites
- High-density electrode spacing
- Large, high-resolution span of electrodes
- Ability to record from all electrode sites, not just a subset like the neuropixel probes
- Improved signal-to-noise (SNR) of acquired signals
- Ultra-compact package
- Multiplexed signals (32:1), reduced connector size

SmartProbe™

MINIATURIZED HIGH CHANNEL COUNT PROBE
WITH ON-BOARD DIGITIZATION

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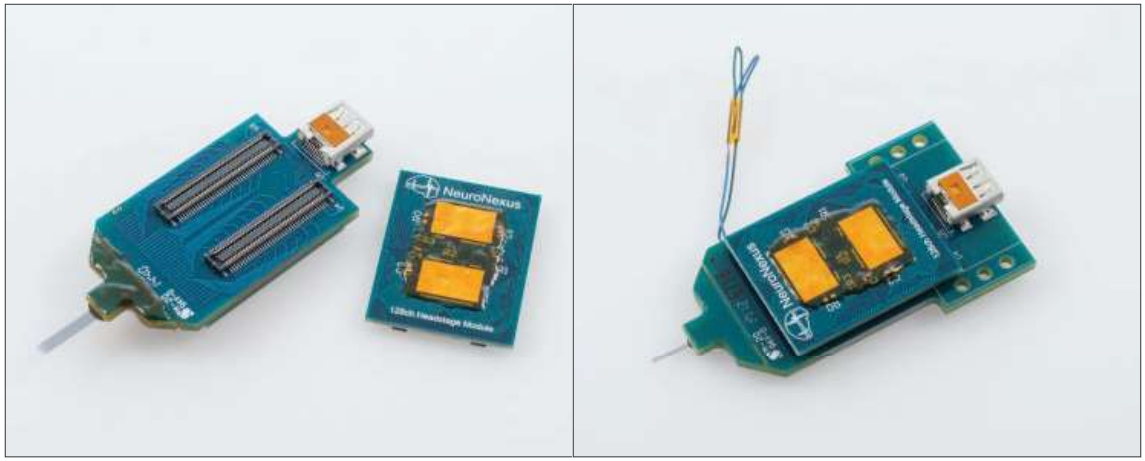

SmartProbe™ enables high channel count electrophysiology with on-board electronics.

- **Integrated headstage and accelerometer** – Neural signals are digitized at the implant site, reducing noise from connectors and movement.
- **Modular components** – The SmartProbe™ utilizes modular headstage boards. Remove the headstage components after your experiment for use with the next probe, and save money in the long run.
- **Reduced strain** – A low connection force using the micro HDMI connector means daily connections can take place more reliably.

DATA ACQUISITION AND CONTROL SYSTEMS

The SmartProbe™ requires a control and acquisition system such as the SmartBox™, or any Intan-compatible system.

Alternatively, conventional probes can be connected to the SmartBox™ with SmartLink headstages.

ARRAY DESIGNS

The SmartProbe™ can be configured with any A-type NeuroNexus electrode array.

Turn to the **Electrode Array Designs** section to review available designs, or **contact us** to design your own electrode array.

SPECIFICATIONS

Channel Count	128, 256
A/D Converter	16-bit ADC
Sampling Rate	Up to 30 kSamples/s
Signal Bandwidth	0.1-100 Hz 0.25 - 7.5 kHz
Electrode Array Length	2 - 10 mm (varies by design)
Electrode Array Thickness	15 µm or 50 µm (varies by design)
Electrode Site Material	Iridium (standard), Platinum (custom), Gold (custom)
Available Packages	S128, H128, S256, H256

Matrix Array™

TRUE 3D NEURAL INTERFACE FOR LARGE AND SMALL ANIMALS

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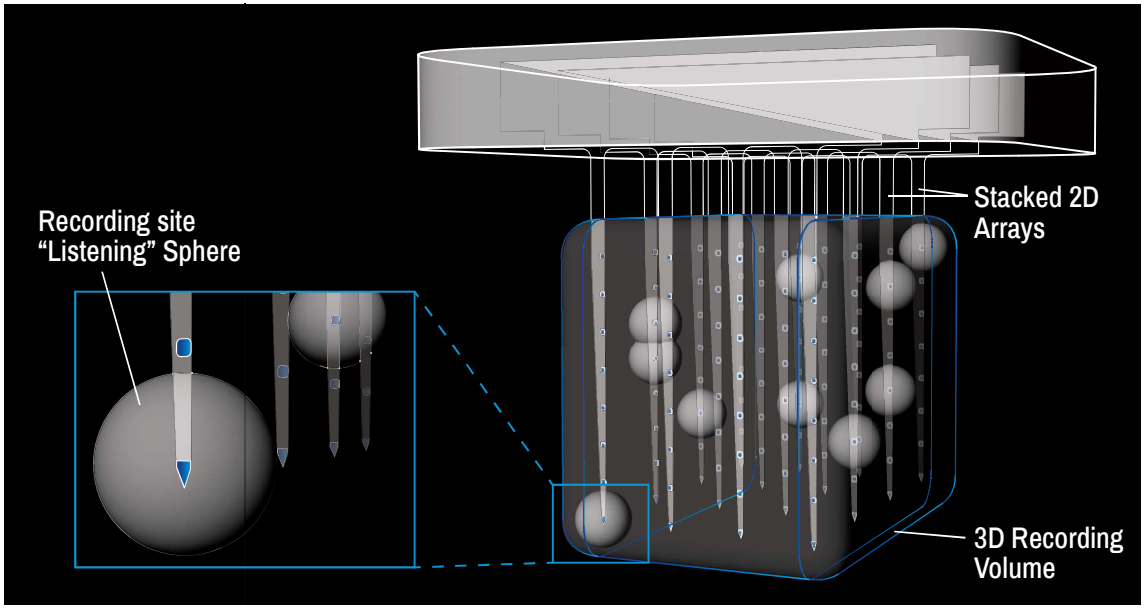


The **Matrix Array™** is a versatile neural interface. It can be used in acute or chronic experiments for both small and large animals, interfacing with large populations of neurons in 3D space, up to 10 mm deep. *See our Matrix Array™ Catalog for full configuration details.*

- **3D Neural Interface** – The Matrix Array™ concurrently spans cortical columns and layers, interfacing with a volume of tissue and large populations of neurons.
- **Robust** – Lab-tested and refined to the smallest detail, the Matrix Array™ can withstand demanding chronic applications.
- **Versatile** – The modular assembly of the Matrix Array allows for varied configurations: record from cortical and/or subcortical areas, as well as from the brain surface, all with the same probe. Electrode length, site area, and shank/site spacing can all be customized for your application.
- **High Channel Density** – Record and stimulate from 64 to 256 channels.
- **Refined surgical procedure** – NeuroNexus worked closely with labs to develop a low-speed, low-risk, automated implantation procedure, reducing recovery time and preserving tissue health.
- **Optogenetics-compatible** – Configure a Matrix Array with an integrated optical fiber for novel optogenetics applications.

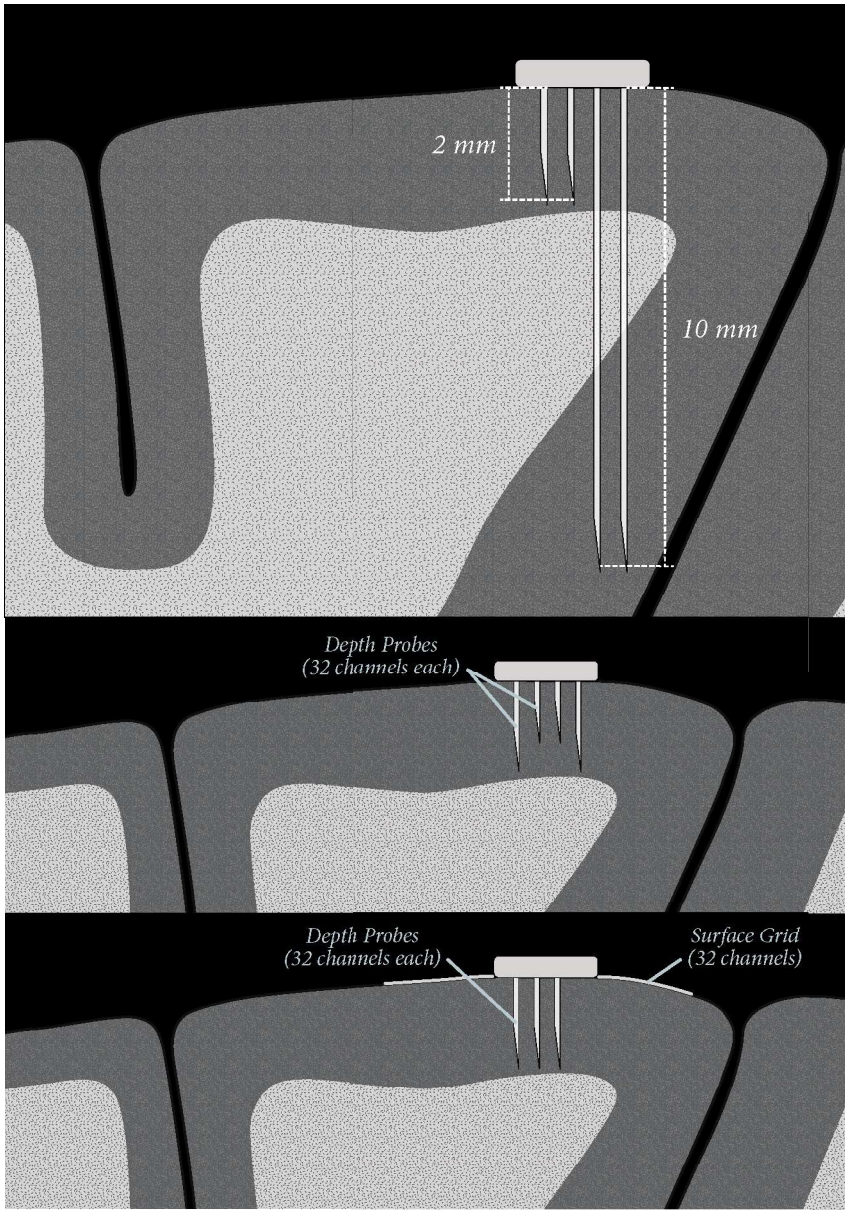
MATRIX ARRAY™ OPTIONS

The Matrix Array unlocks 3D neural interfacing in a wide variety of applications:

Acute
Matrix Arrays can be configured for acute work with any animal model.

Chronic Small Animal
Compact 64- or 128-channel Matrix Arrays can be configured for chronic small animal applications.

Chronic Large Animal/Primate
Robust large animal packages have been extensively tested and proven over months in labs performing primate research.



Above: *Illustrations of potential Matrix Array™ configurations. Top: Combine short and long array designs to target both the sulcus and gyrus. Middle: Combine array designs of different lengths to target adjacent cortical layers. Bottom: Combine depth probes with surface grids.*

Matrix Arrays™ offer unique potential to understand neuronal networks in novel ways.

The support structure of the Matrix Array™ is a silicon platform where our industry-standard 2D silicon electrodes are installed. Both the slot spacing and the 2D electrode array combination can be customized, giving you unsurpassed flexibility in customizing a true 3D probe capable of spanning any anatomical structure. An ultra-flexible cable assembly connects the Matrix Array™ to conventional percutaneous connectors.

- Configure electrode length, site area, spacing; combine different 2D array designs for a tailored neural interface.
- Silicon platform comes with 2D arrays spacing ranging from 200-2000 um.
- Penetrating arrays can be combined with surface ECoG grids

SPECIFICATIONS

Channel Count	64, 128, 256 (see following pages)
X-Axis (2D Array) Dimension	1800 µm max width
Y-Axis (2D Array) Spacing Options	200 µm, 300 µm, 400 µm, 600 µm, 800 µm, 1000 µm, 2000 µm (specify when ordering)
Z-Span (Depth)	Up to 10 mm (varies by array design/ selection)
Cable Length (distance from implant to connector)	30 mm, customizable up to 50 mm
Electrode Site Material	Iridium (standard), PtIr (standard), Platinum (custom), Gold (custom)
Electrode Array Thickness	50 µm

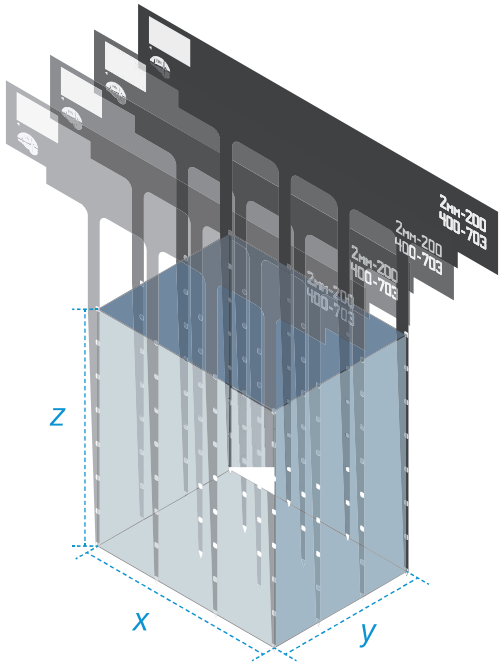
How to Configure a Matrix Array™

Step 1: Select an appropriate package for your experiment type and animal model. (See **Matrix Selection Guide,** next page.)

Step 2: Select 2D Arrays. Each 2D array has 32 electrode sites - for a 64-channel Matrix Array™, select two 2D arrays. For a 128-channel Matrix Array™, select four. You may combine different 2D Arrays in your selection, or include ECoG arrays for combined depth and surface recording.

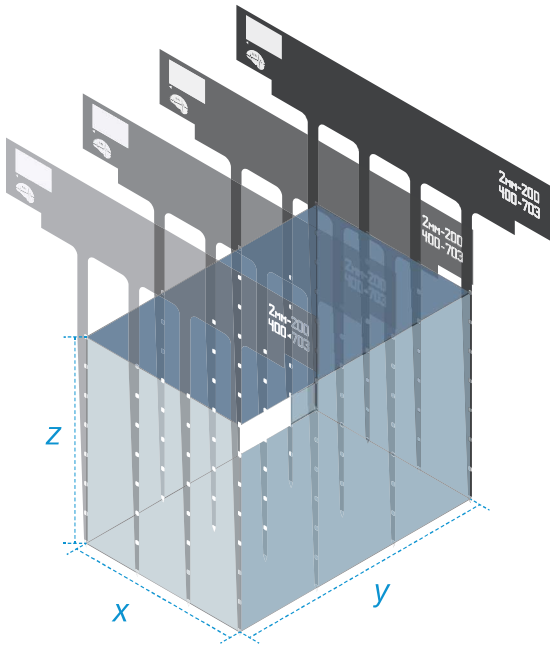
Step 3: Select a platform spacing. The illustration below shows tissue coverage with 3 of the 7 different platform spacings available. In this example, the M4x8-2mm-200-400-177 is used; to calculate tissue coverage for your design, use the dimensions available on the following pages.

300 µm spacing



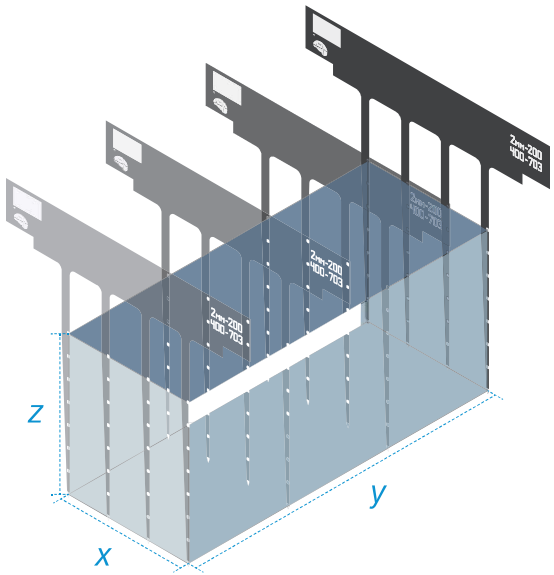
x: 1200 µm
y: 900 µm
z: 1400 µm
volume: ≈ 1.512 mm³

600 µm spacing



x: 1200 µm
y: 1800 µm
z: 1400 µm
volume: ≈ 3.024 mm³

1000 µm spacing



x: 1200 µm
y: 3000 µm
z: 1400 µm
volume: ≈ 5.04 mm³

MATRIX SELECTION GUIDE

PACKAGE	ANIMAL MODEL	PACKAGE FEATURES	CHANNEL COUNT	APPLICATION	CABLE	32-CHANNEL 2D PROBE SPACING (PLATFORM)	CONNECTORS
MCM Matrix CM-Series	Small	Polymer	64 or 128	Acute / Chronic	N/A	200 µm 600 µm 300 µm 800 µm 400 µm 1000 µm	Omnetics NSD36 (4 guideposts)
MH Matrix H-Series	Small	Polymer	64 or 128	Chronic	22 mm 25 mm 30 mm	200 µm 600 µm 300 µm 800 µm 400 µm 1000 µm	Omnetics NSD36 (4 guideposts)
MHS Matrix H-Series, Strengthened	Medium	Polymer and metal supported	64 or 128	Chronic	22 mm 25 mm 30 mm	200 µm 600 µm 300 µm 800 µm 400 µm 1000 µm	Omnetics NSD36 (4 guideposts)
MHD Matrix Pedestal	Large	Titanium with stand off	128 / 256	Chronic	35 - 40 mm	200 µm 600 µm 300 µm 800 µm 400 µm 1000 µm	NN-HD
MHD_Dual Matrix Pedestal, Dual Platform	Large	Titanium with stand off	128 / 256	Chronic	Dual 35 - 40 mm	200 µm 600 µm 300 µm 800 µm 400 µm 1000 µm	NN-HD
MHDLP Matrix Low Profile	Large	Titanium	128 / 256	Chronic	35 - 40 mm	200 µm 600 µm 300 µm 800 µm 400 µm 1000 µm	NN-HD
MA Matrix Acute	Small/Medium	SS Y-Bracket	64 or 128	Acute	N/A	200 µm 600 µm 300 µm 800 µm 400 µm 1000 µm	Omnetics NSD36 (4 guideposts)

MATRIX PACKAGES

Small

MCM64 on Rat Skull

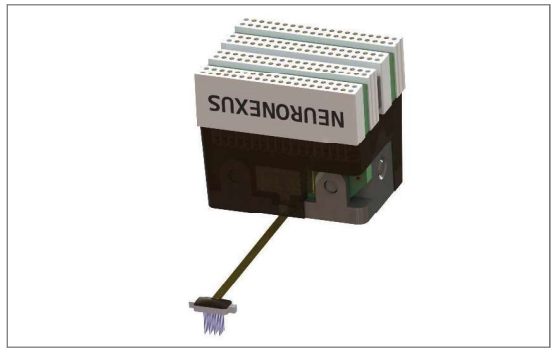
MH64

Small Matrix Array Packages

MCM64	MA64
MCM128	MA128
MH64	
MH128	

Medium

MA128 (Acute Matrix Array)



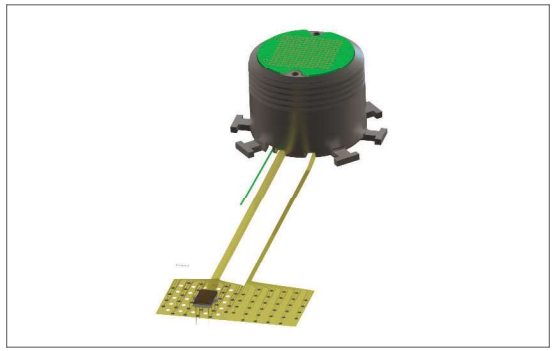
MHS128

Medium Matrix Array Packages

MHS64	MA64
MHS128	MA128

Large

MHD_Dual256



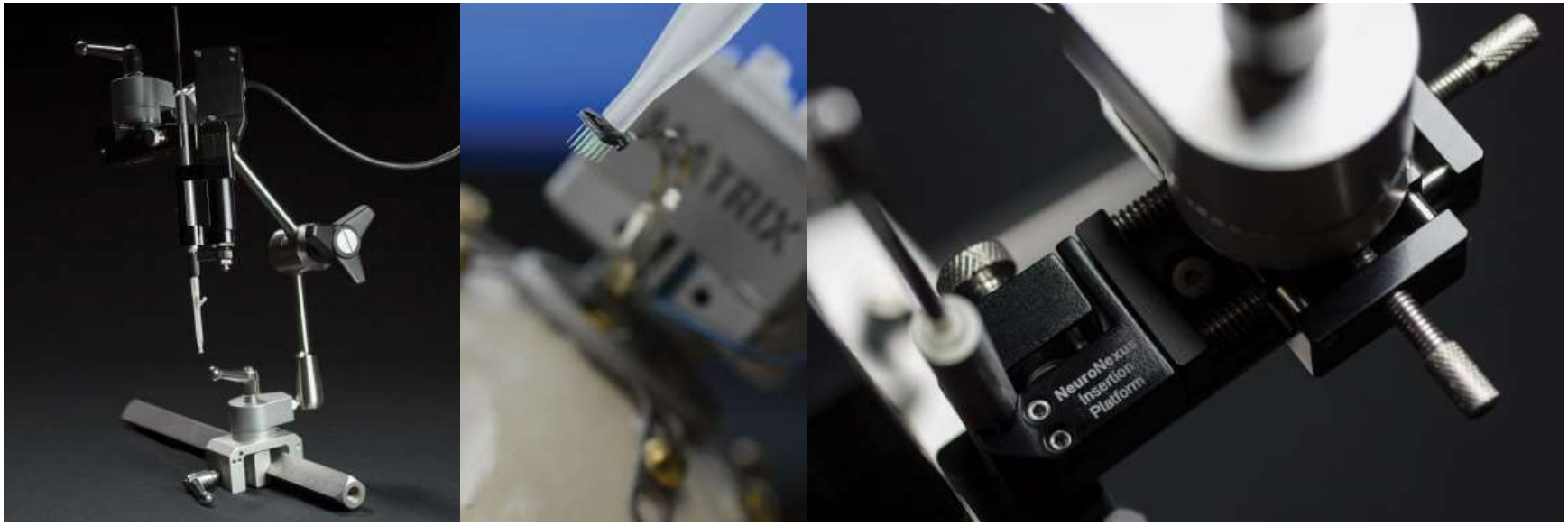
MHDLP256 (Shown with surface arrays)

Large Matrix Array Packages

MHD64	MHDLP64
MHD128	MHDLP128
MHD256	MHDLP256
MHD_Dual128	MA64
MHD_Dual256	MA128

Matrix Package Naming Key:

CM = Cableless	*HD = Primate / Pedestal*
H = Cable	*LP = Low Profile / No feet*
S = Strengthened	*Dual = Dual Platform*



The **Matrix Insertion Tool** (above, left, mounted on **All-Angle Arm** and attached to a Kopf® rail) is a computer-controlled, precision linear actuator to support surgical implantation of NeuroNexus arrays. Through an intuitive software application, arrays can be implanted to precise locations, at speeds most suitable for each application.

The Insertion Tool can be mounted to standard stereotaxic manipulators. All NeuroNexus probe packages are compatible.

The Matrix Insertion Tool is ideal for insertion of our Matrix Arrays™. The carefully calibrated insertion minimizes damage from excessive insertion force. The IST-Matrix utilizes vacuum suction to hold the Matrix Array™ during insertion, allowing for an easy, vibration-free release after implant.

SPECIFICATIONS (INSERTION TOOL)

Speed	0.22 µm/s - 8 mm/s (0.5 - 2 mm/s recommended)
Travel Range	0 - 50 mm
Accuracy	30 µm
Step Size	0.05 µm
Dimensions	150 mm (L) x 30 mm (W) x 20 mm (H)

SPECIFICATIONS (ALL-ANGLE ARM)

Total Length	245 mm
Range of movement	Fully articulated positioning arm: 90° pivotable and 360° rotatable ends, 360° rotatable elbow
Insertion Platform	± 5 mm in 2 axes

Qtrode

4-CHANNEL PROBE / WIRE TETRODE UPGRADE

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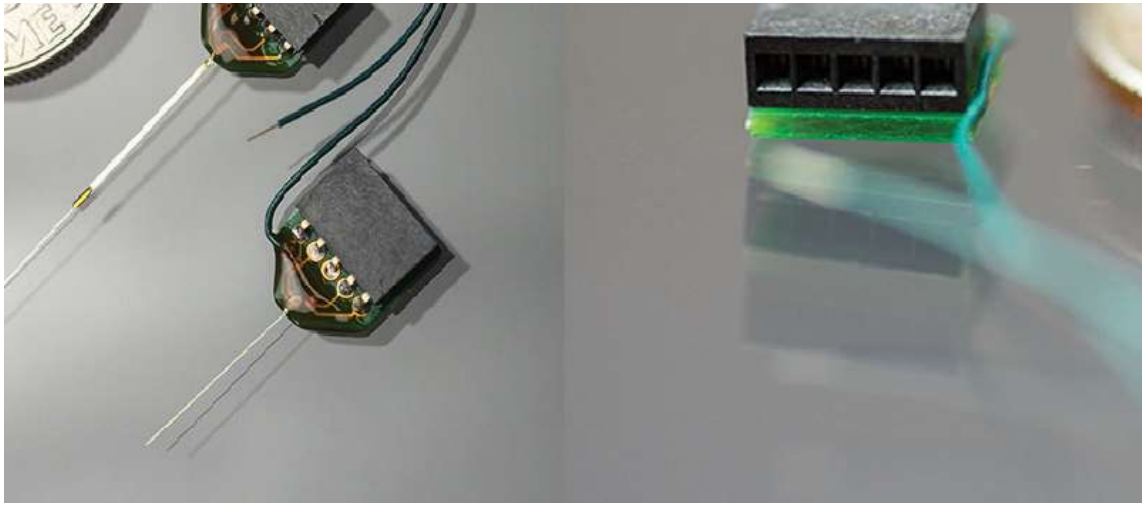
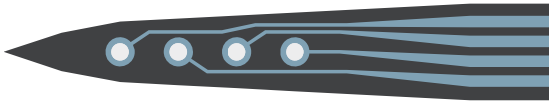


NeuroNexus **Qtrodes** are low-cost 4-channel probes designed to replace tetrodes and/or wires in your lab. Qtrodes are also ideal for acute or chronic experiments requiring lower channel counts.

- **Predictable geometry** – Obtain consistent recording results with precise, reproducible geometry and electrical characteristics from our silicon probes.
- **Optogenetics-compatible** – Combine an acute or chronic Qtrode with an optical fiber to combine electrophysiology with optogenetic stimulation. Opto-Qtrodes use the "O" prefix designation, e.g. "OCQ4."
- **Improved Chronic experiments** – Combine a Qtrode with a microdrive for potentially better chronic experiment longevity and data yield.

- **Fast Delivery** – Qtrodes are stocked for quick shipment and delivery. Please note there is a minimum order of 5 Qtrodes. (This applies to all models.)

LINEAR



TETRODE

Above: Qtrodes come in linear and tetrode site layouts

SPECIFICATIONS

Electrode Site Material	Iridium (standard),
Electrode Thickness	15 µm or 50 µm (varies by design)
Electrode Length	3, 5, 10 mm (varies by design)
Site Layout	Linear or Tetrode
Channel Count	4

3

Targets 10 mm or deeper

Vector Array™

DEEP BRAIN PROBE / ACUTE, CHRONIC, AND OPTOGENETICS

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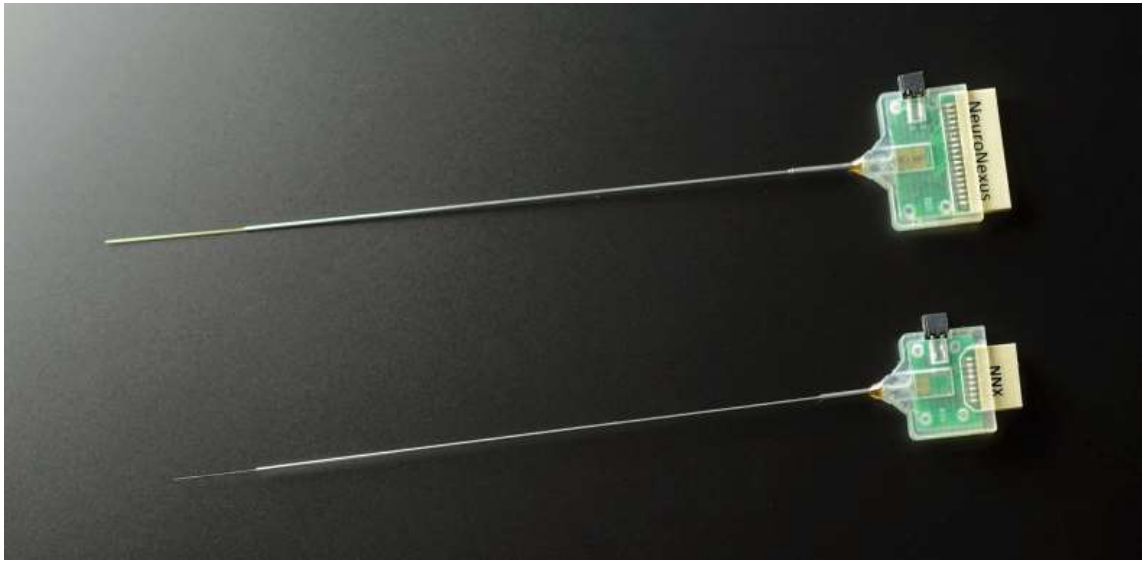
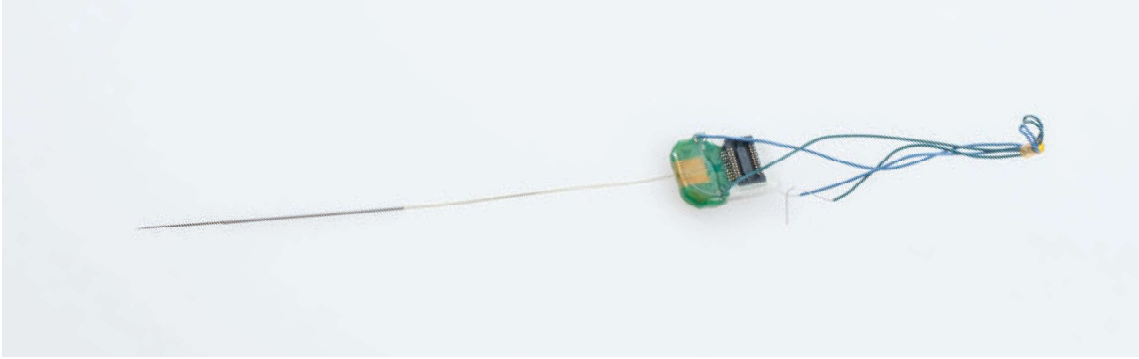


The **Vector Array™** is optimized for deep brain applications, utilizing NeuroNexus microelectrode technology to record and stimulate in high resolution in hard-to-reach structures. Vector Arrays™ are compatible with NaN and Narishige drives.

- **Reach deep brain structures** – The Vector Array™ comes in 70 mm and 110 mm implantable lengths to reach deep structures in large animal models.
- **High Resolution** – Record and/or stimulate with 16, 32, or 64 channels. The Vector Array™ features the same precise electrode geometry and contact density as other NeuroNexus microelectrode arrays.
- **Versatile** – Configure the Vector Array™ for acute or chronic applications.
- **Optogenetics-Compatible** – An optical fiber can be mounted on the Vector Array™ for optogenetics applications. (See Specifications for fiber options. Opto-Vector packages use "OV" designation.)
- **Options, options** – Specify a laminar array design, or utilize multiple representation techniques with a Poly2 contact layout. Alternatively, design your own custom Vector Array.
- **Robust Hybrid assembly** – The Vector Array™ combines a high-resolution silicon MEA with a rigid stainless steel support body. This arrangement provides strength where needed, while minimizing tissue damage at the recording sites.
- **Inexpensive** – With a low cost per use, the Vector Array™ increases your data yield while saving you money.

Left: *16- and 32- channel Vector Arrays*
Below: *64-channel Vector Array on a US penny*

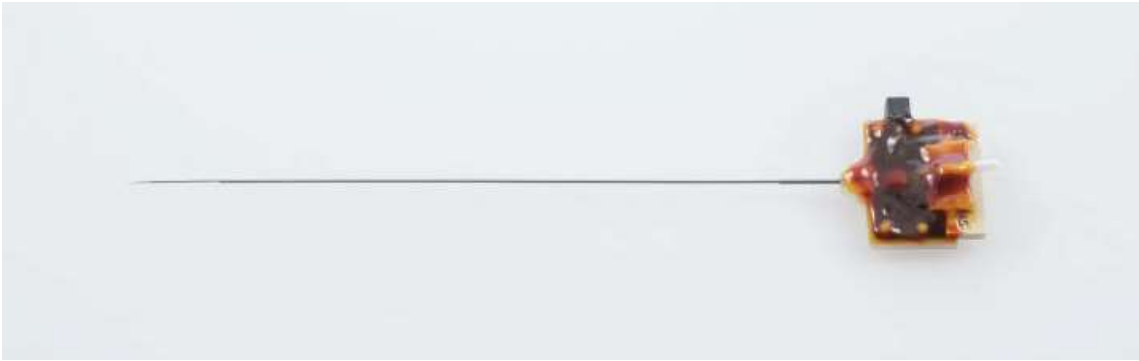
CHRONIC VECTOR ARRAY™



The Chronic Vector Array™ is a new design enabling access to deep brain structures (> 10 mm deep) during chronic applications.

Chronic Vector Arrays™ can be configured with implantable lengths from 30 - 55 mm. Please factor in implantation hardware (clamps, etc.) when configuring your probe.

OPTO VECTOR ARRAY™



FLAT FIBER OPTIONS (ID / OD / NA)
50 µm/70 µm, 0.22 NA (flexible)
50 µm/62.5 µm, 0.22 NA (etched)
105 µm/125 µm, 0.22 NA (standard)
105 µm/125 µm, 0.66 NA (Plexon patch cords)
200 µm/220 µm, 0.22 NA

SPECIFICATIONS

Channel Count	16, 32, 64
Total Length	*Acute:* 70mm or 110mm (specify support tube length when ordering) *Chronic:* 30 - 55mm (specify when ordering)
Silicon Electrode Length	10 mm
Silicon Electrode Width	20 µm min (Edge design), 75 µm min (Poly2 design), 275 µm max
Silicon Electrode Thickness	50 µm
Site Area	177 μm^2
Site Coverage	375 µm - 6300 µm, depending on design
Electrode Site Material	Iridium
Site Target	Single Unit or LFP/ Stimulation
Support Body Diameter	315 µm OD (16-channels) 400 µm OD (32- and 64-channels)
Available Packages	V16, V32, V64, VC16, VC32, VC64, VZ16, VZ32, VZC16, VZC32

4 Surface Arrays

EEG

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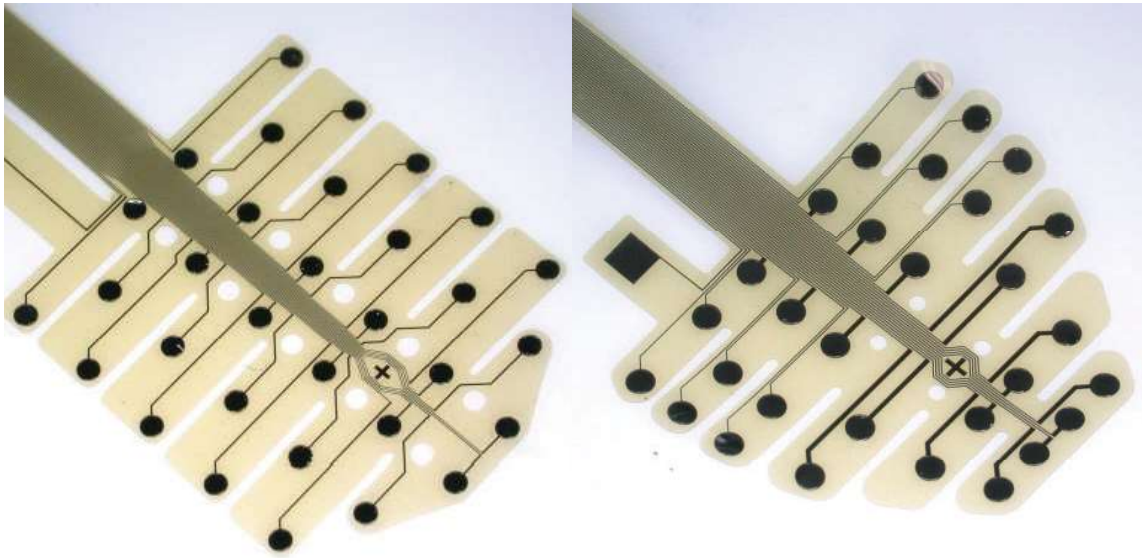

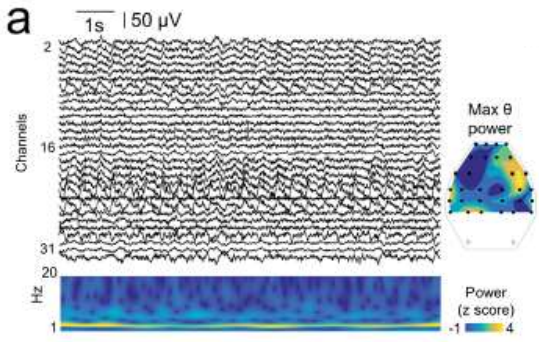

ABOVE: EEG grids allow assessment natural brain rhythms such as exploratory and REM theta (4-12 Hz) during periods free of epileptiform activities. Image courtesy of Dr. Liset de la Prida, Instituto Cajal - CSIC. https://hippo-circuitlab.com/2017/03/eeg-grids/

NeuroNexus **EEG probes** are ultra-flexible surface grids optimized for electroencephalography.

- **Flexible and durable** – Fabricated with our polymer MEMS technology, our EEG probes easily conform to the skull. Use a drop of water to adhere the probe to the skull.
- **Stable** – High quality EEG recordings have been obtained over months.
- **Optimized array designs** – Select from a variety of EEG array designs featuring different recording site placements, for different applications or animal models.

SPECIFICATIONS

Substrate Material	Polyimide
Electrode Site Material	Platinum
Array Thickness	15 µm
Cable Length	10 mm
Channel Count	16 (downsampled Rat EEG) 30 (Mouse EEG), 32 (all other designs). Custom options available.
Available Packages	H16, H32, HC32, HZ32

ECoG

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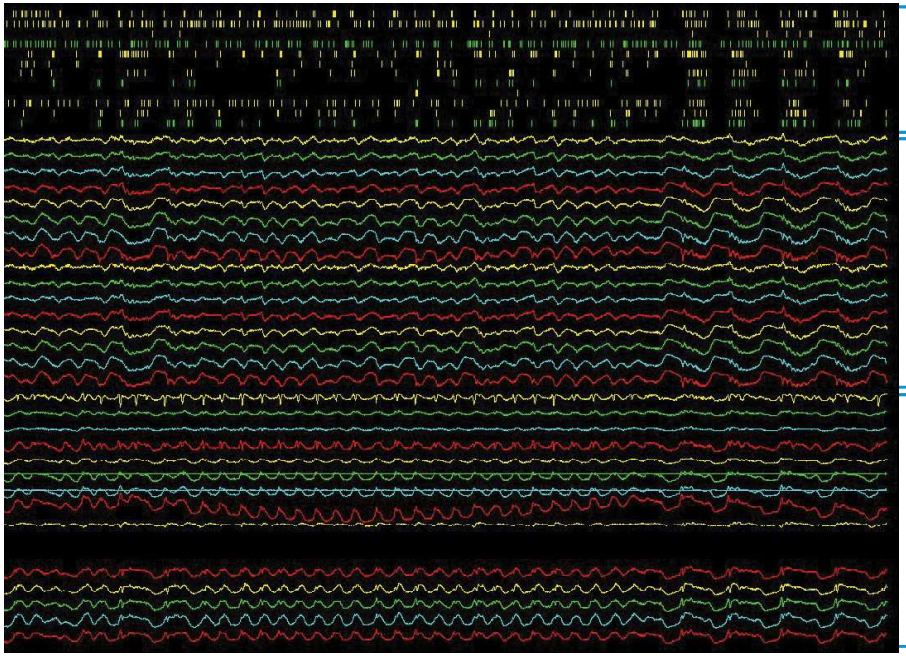

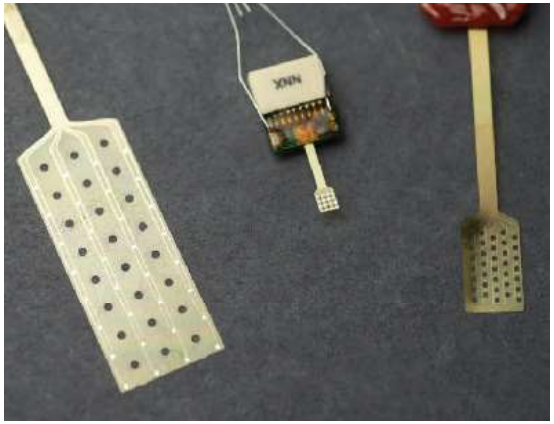

ABOVE: ECoG probes are available in different sizes and site configurations for different applications.

NeuroNexus **ECoG probes** are ultra-flexible surface grids with high recording resolution, designed to conform closely to the brain surface for electrocorticography.

- **Flexible and durable** – Fabricated with our polymer MEMS technology, our ECoG probes conform to the brain surface.
- **Optimized array designs** – Select from a variety of ECoG array designs featuring different site spacings, for different applications or animal models.
- **Versatile** – Combine an ECoG probe with a NeuroNexus penetrating array to establish concurrent surface and intracortical interfaces.

SPECIFICATIONS

Substrate Material	Polyimide
Electrode Site Material	Platinum
Array Thickness	15 µm
Cable Length	5 - 30 mm (varies by design)
Channel Count	16, 32, 64 (varies by design)
Available Packages	H16, HC16, HZ16, H32, HC32, HZ32, H64, H64LP, HC64, HZ64

Cardiac Surface Grids

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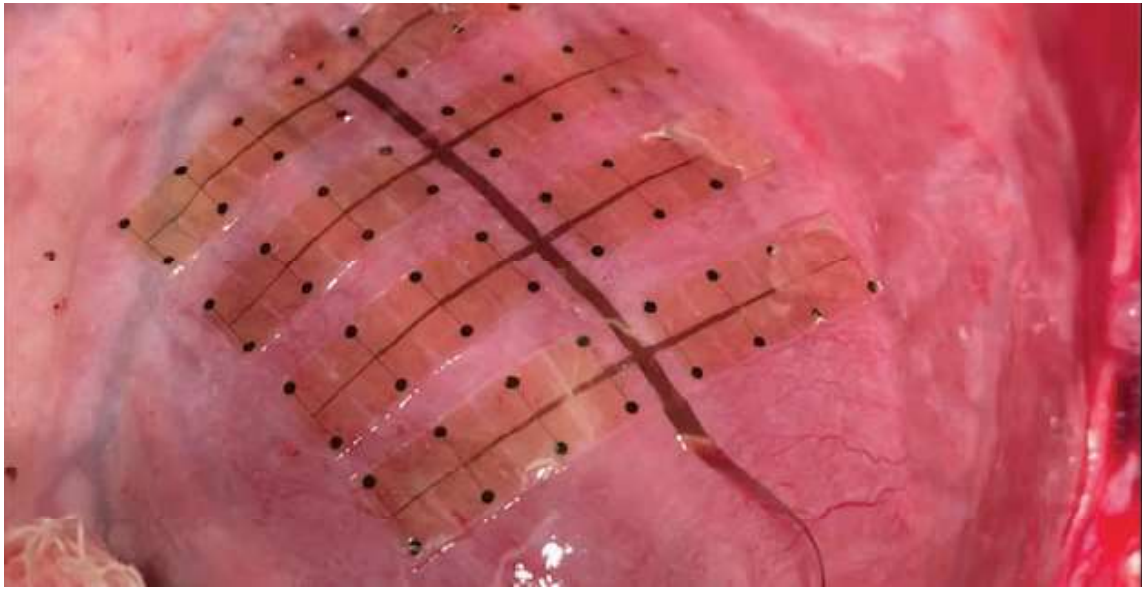
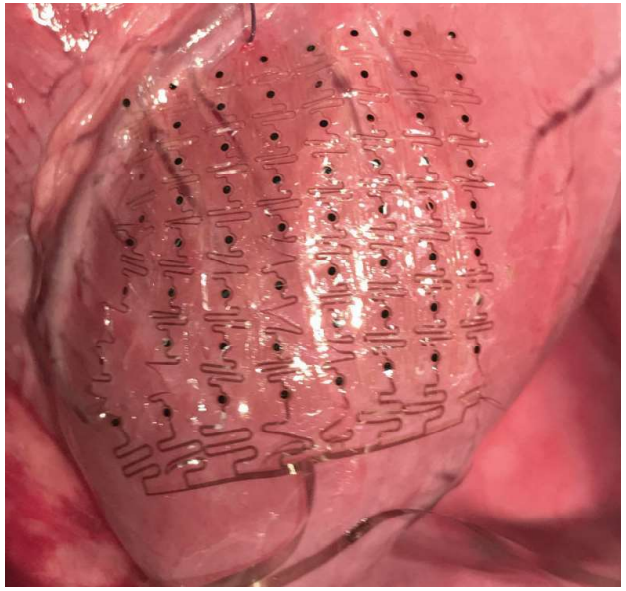


ABOVE: NeuroNexus Cardiac Surface Grid on heart surface



ABOVE: NeuroNexus Cardiac Surface Grid on heart surface

NeuroNexus **Cardiac Surface Grids** are fabricated using our polymer MEMS technology, resulting in an ultra-flexible substrate designed to conform to the cardiac surface. Cardiac Surface Grids can be combined with penetrating probes.

- **High recording resolution** – Discover fine detail with our unique high-resolution cardiac grids.
- **Vast design space** – Grids can be customized to your specific needs. Adjust size, channel count, contact density, and more. Special features can be integrated to cope with the particular demands of neurocardiology.
- **Low noise from tissue movement** – Our cardiac grids have been engineered and tested to minimize noise from tissue movement.

SPECIFICATIONS

Substrate Material	Polyimide
Electrode Site Material	Platinum
Array Thickness	15 µm
Channel Count	16, 32, 64 (varies by design)
Available Packages	H16, H32, H64, H64LP

Peripheral Nerve Cuffs

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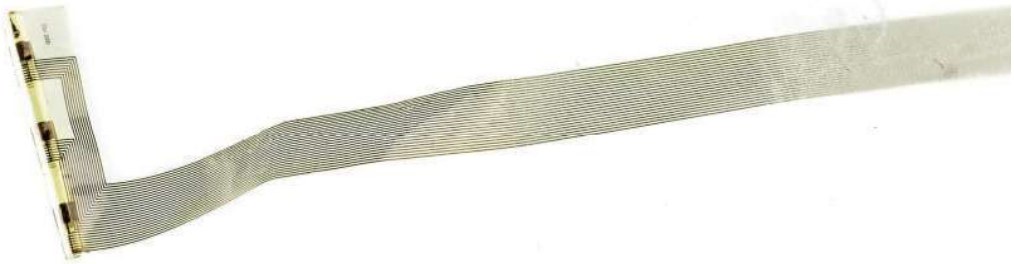

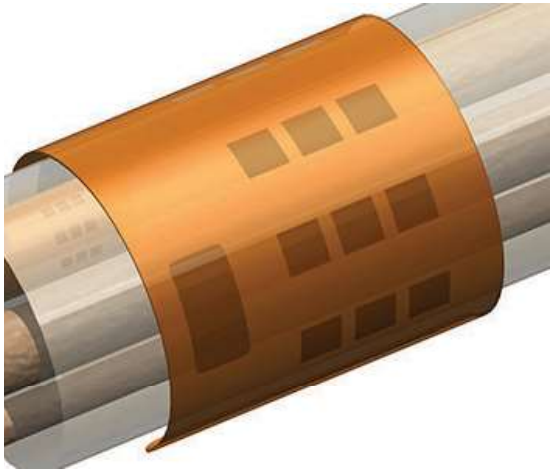

ABOVE: NeuroNexus Nerve Cuffs can be pre-curved to fit any diameter.

NeuroNexus **Nerve Cuffs** enable high-resolution recording and stimulation in peripheral nerve applications. Nerve Cuffs can be custom designed and pre-curved to interface with a variety of nerves.

With a thickness of merely 15 µm, the Nerve Cuff is extremely flexible, allowing it to be wrapped around a nerve. Our versatile MEMS process lets you design recording and stimulation sites in almost any configuration to meet your experimental needs.

Alternatively, a sieve-type microelectrode array can be realized by designing arrays with holes, which can be seeded with neural growth factor to promote axonal growth through the microelectrode sites.

SPECIFICATIONS

Substrate Material	Polyimide
Electrode Site Material	Platinum
Array Thickness	15 µm
Channel Count	3, 24 (varies by design)
Available Packages	H16, H32

5

Special Applications

Optoelectrodes

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Illustration showing flat optical fiber mounted on an electrode array shank.

NeuroNexus **Optoelectrodes** enable concurrent optogenetic stimulation and high-resolution electrophysiology.

- **A powerful tool** – Optical fibers are laminated onto silicon probes to create an optoelectrode. Utilize a single fiber, or configure multiple fibers on a single probe (one fiber per electrode shank) to activate different opsins or target different brain areas.
- **Options, options** – Utilize any electrode array design and select from multiple fiber types (and specify their termination locations on each shank) to create your ideal optoelectrode. Optogenetics packages use the "O" prefix (e.g. OA, OCM).
- **Minimal tissue damage** – New OptogeniX fibers taper to a point for minimal impact on brain tissue.
- **Controlled artifact** – NeuroNexus optoelectrodes are engineered for minimal photoelectric artifacts.

FIBER OPTIONS

NeuroNexus offers multiple types of optical fiber, with different diameters, tip profiles, and numerical aperture values. Please consider the best option for your application.

Flat Profile
Inner diameter/Outer diameter, Numerical Aperture

50 µm/70 µm, 0.22 NA (flexible)
50 µm/62.5 µm, 0.22 NA (etched)
105 µm/125 µm, 0.22 NA (standard)
105 µm/125 µm, 0.66 NA (Plexon patch cords)
200 µm/220 µm, 0.22 NA

Tapered Profile (OptogeniX)
Inner diameter/Outer diameter, Numerical Aperture

105 µm/125 µm, 0.22 NA
200 µm/225 µm, 0.39 NA
200 µm/230 µm, 0.66 NA

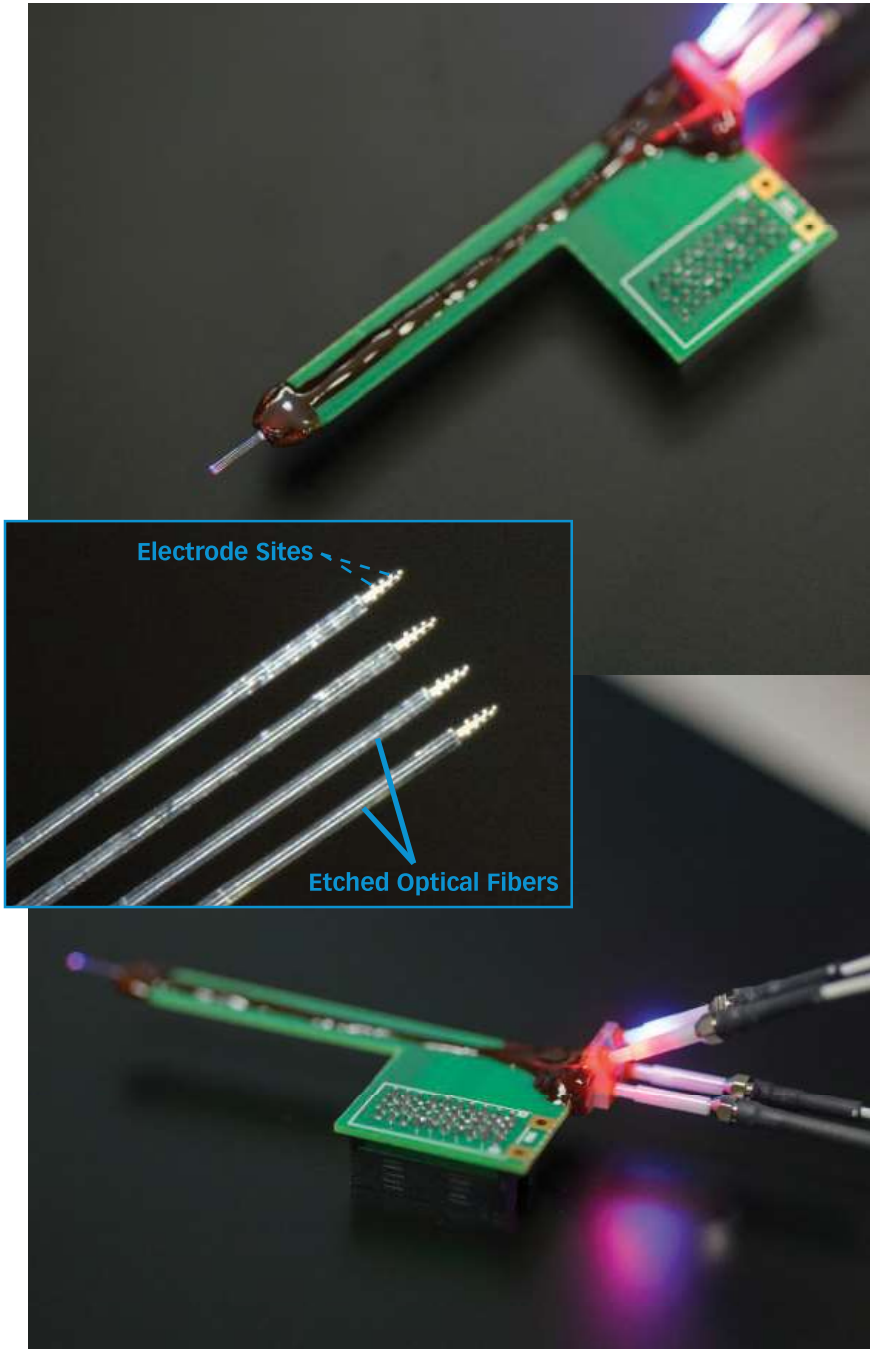
More information on following pages.

MULTI-FIBER OPTOELECTRODES

NeuroNexus offers **multi-fiber optoelectrodes** for expanded optogenetics applications in a compact, robust package.

Using acid etched optical fibers (65 µm), up to 8 fibers can be attached to each probe (one fiber per electrode array shank). Because of the physical limitations of optical fibers and NeuroNexus microelectrode arrays, there are some design constraints.

RIGHT, TOP: Quad-optrode package showing lit fibers
RIGHT, BOTTOM: Compact ceramic ferrule attachment
INSET: Close-up image of a Buzsaki32 electrode array showing mounted fibers



SPECIFICATIONS (FLAT FIBER)

Fibers (ID/OD, NA)	50 µm/70 µm, 0.22 NA (flexible) 50 µm/62.5 µm, 0.22 NA (etched)
Fiber Tip Profile	Flat
Weight (Coupler)	< 0.5 g
Durability	< 5% transmission variability after 40 connections
Rotation Test	< 2% variation over 1 rotation
Connection Strength	> 300 g before latch separation (typical)
Maximum Shear Force	900 g (applied to top of female coupler)
Length	Tolerance ± 500 µm

TAPERED FIBERS

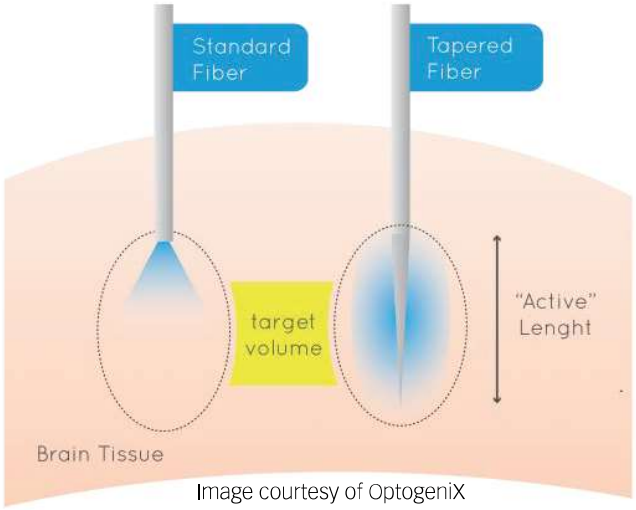


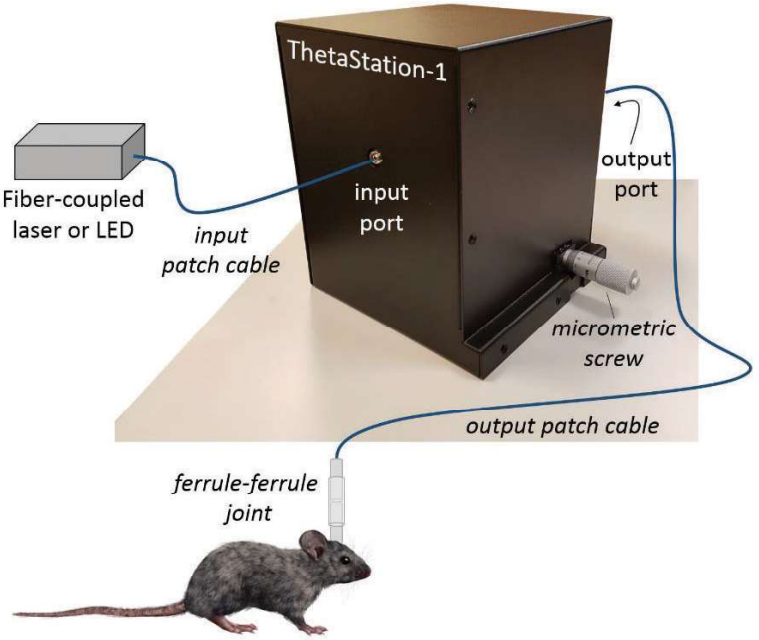
Image courtesy of OptogeniX

OptogeniX Tapered Fibers can also be specifi ed for a NeuroNexus optoelectrode:

- OptogeniX tapered fibers are designed to illuminate large volumes of tissue in a more homogeneous way than standard optical fibers.
- Gain stimulation efficiency, with less tissue damage.
- Sub-sample your target region – without probe movement – by using an OptogeniX Launching System like the **ThetaStation** (right).

OPTOGENIX THETASTATION

The OptogeniX **ThetaStation-1** is an opto-mechanical tool designed to perform *in vivo* site-selective stimulation with OptogeniX tapered fibers. ThetaStation-1 can be operated with any fiber-coupled source of visible light (either a laser or an LED).

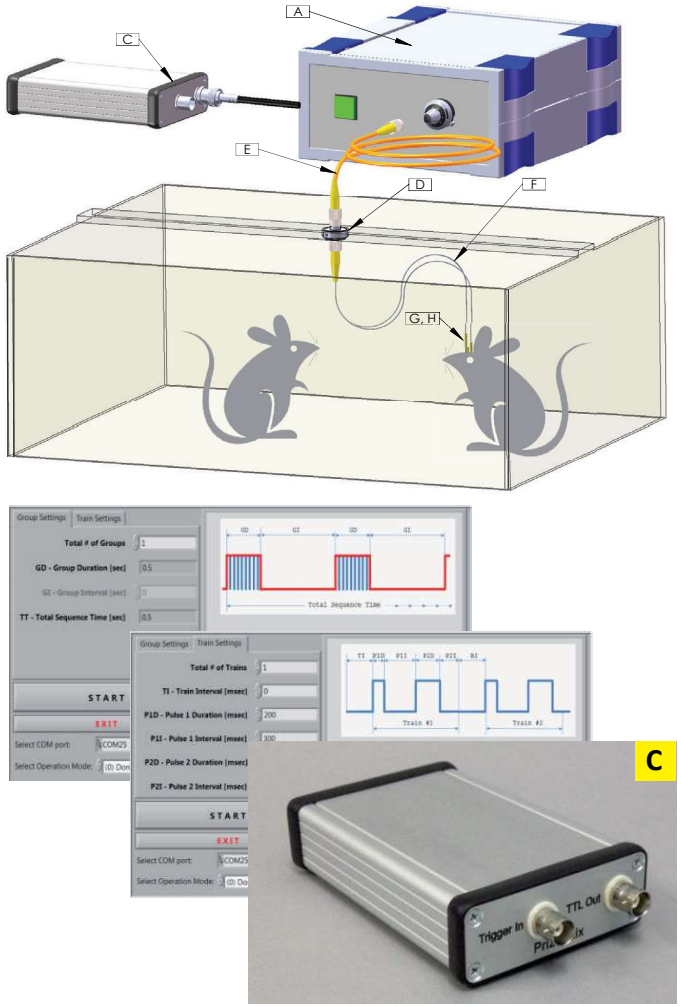


SPECIFICATIONS (TAPERED FIBER)

Fibers (ID/OD, NA)	105 µm/125 µm, 0.22 NA 200 µm/225 µm, 0.39 NA
Fiber Tip Profile	Tapered
Active Length (5% tolerance)	125 µm OD fiber: 0.5 mm, 1 mm, 1.5 mm 225 µm OD fiber: 0.5 mm, 1.0 mm, 1.5 mm, 2.0 mm, 2.5 mm

PRIZMATIX HIGH-POWER LED SYSTEMS

in vivo Applications



A. Optogenetics-LED	Blue (ChR1,ChR2), Green (ArchT), Red (eNpHR3.0, red-shifted ChR) ultra-bright fiber coupled LEDs for *in vivo* optogenetics
B. Dual-Optogenetics-LED	Dual (Blue, Green, Red) ultra-bright fiber coupled LEDs with independent channels
C. Pulser	TTL pulse train generator featuring simple PC software for pulse programming
D. Rotary Joint	Low friction fiber optic Rotary Joint for *in vivo* optogenetics with small animals
E. Optogenetics-Fiber-1000	Polymer optical fiber, High NA, 1000 µm core, SMA to FC connectors
F. Optogenetics-Fiber-500 / Optogenetics-Fiber-2x500	Polymer optical fiber, High NA, 500 µm core, FC to ferrule. Dual (2x500) bundle available for bilateral stimulation
G. Sleeves	Zirconia sleeves for 2.5 mm or 1.25 mm cannulae
H. Implantable Cannulae	Ferrules diameters: 2.5 mm and lightweight 1.25 mm for smaller animals as mice

Drug Delivery

COMBINED DRUG DELIVERY AND ELECTROPHYSIOLOGY

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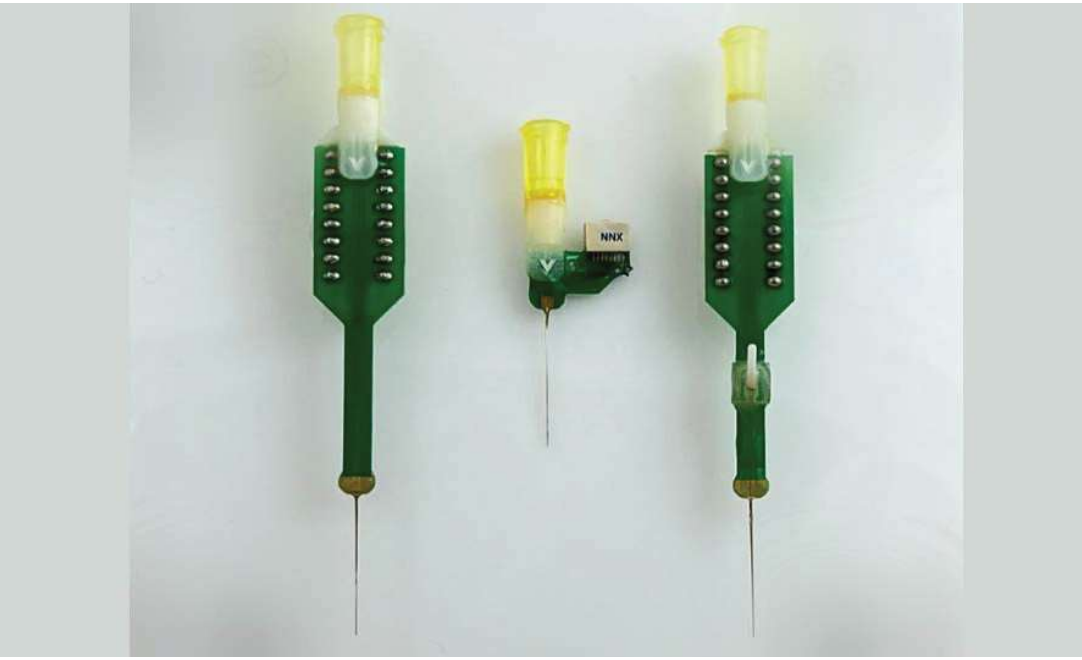

The E16-20mm-100-177 electrode array can be mounted on a fluidic tube to combine drug delivery and electrophysiological recording.

The fluidic tube is mounted on the lower side of the microelectrode array, and the delivery port is at the distal end of the fluidic tube. The fluidic interface is compatible with standard **Luer taper** fittings for interfacing with external injection pumps. Typically, a pressure-based delivery mechanism is used.

The acute drug delivery array can be configured with an optical fiber. As with many of our products, the fluidic probe can be customized. Contact us for your customization needs.

SPECIFICATIONS

Electrode Site Material	Platinum
Total Probe Thickness	≈185 µm
Coupling Conduit	Luer taper (polypropylene)
Fluidic Tube	32 gauge / 0.241 mm Stainless steel
Fluidic Port Tip Angle	90° (standard), 45°
Implantable Length	15 - 18 mm
Electrode Coverage	1.5 mm
Channel Count	16
Available Packages	D16, DM16, OD16LP

MR-Compatible

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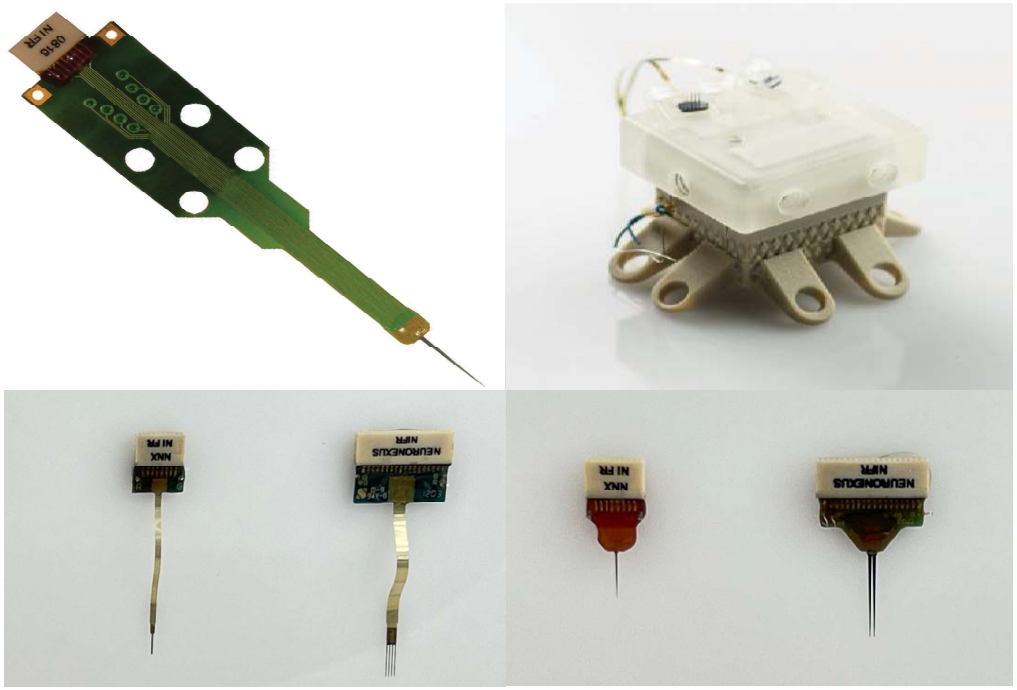

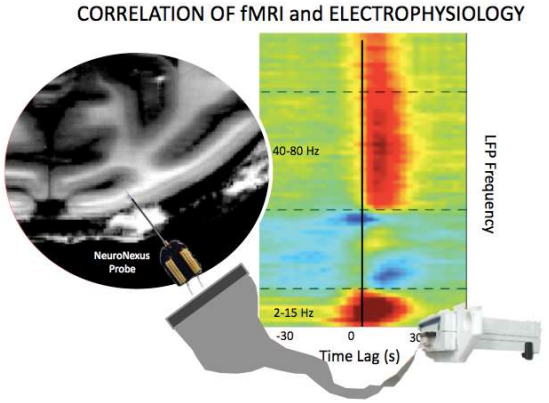

When configured with the MR-Series Package, NeuroNexus probes include only trace amounts of ferromagnetic material and cause minimal or no distortion during typical MR imaging. Most of our Omnetics connector-based packages can be made MR compatible. Please contact us for details.

Above: *MR-Compatible probes use special Omnetics connectors, marked "NI FR."*
Top Right: *The Matrix Array can be made MR-Compatible for chronic MRI applications in small and large animals..*

SPECIFICATIONS

Electrode Site Material	Iridium (standard), Platinum (custom), Gold (custom)
Electrode Thickness	15 µm or 50 µm (varies by design)
Electrode Length	2 - 15 mm (varies by design)
Channel Count	16, 32, 64 (varies by design)
Available Packages	MRA16, MRCM16, MRCM32, MRHC16, MRHC32, MRH16, MRH32, MRHC64_30mm, Matrix Array

In Vitro

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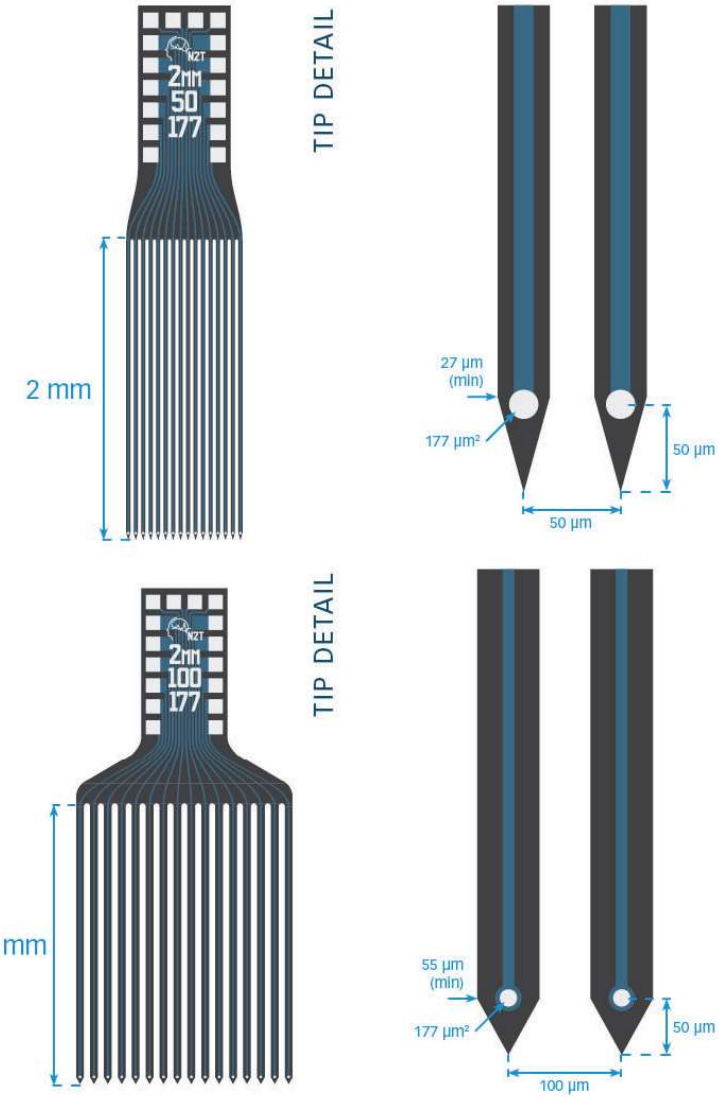

Designed by Dr. Liset Menendez de la Prida at Instituto Cajal – CSIC, the A16x1 microelectrode array is designed specifically for *in vitro* slice applications. Its 16 tip sites, along with its slender comb design, enable high-resolution in vitro research.

"Both single-cell activity and field potential population events can be easily recorded. The linear array allows for propagation studies both in vitro and in vivo and it can be used for current source density analysis in slices."
- Dr. Liset Menendez de la Prida, *Instituto Cajal - CSIC*

SPECIFICATIONS

Electrode Site Material	Iridium (standard),
Implantable Length	2 mm
Total Horizontal Coverage	750 µm or 1500 µm
Channel Count	16

rDBSA

HIGH RESOLUTION DEEP BRAIN STIMULATION

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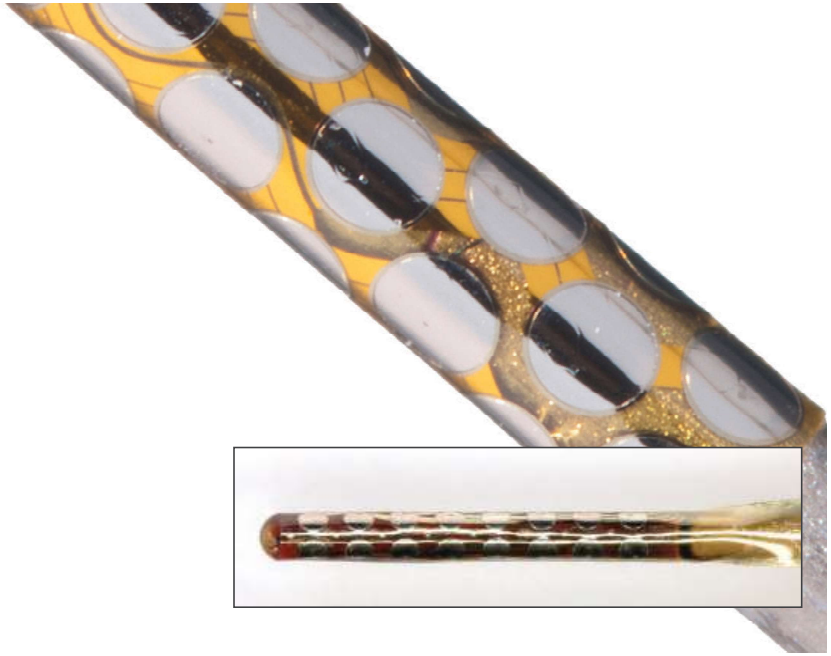

SPECIFICATIONS

Electrode Site Material	Platinum
Substrate Material	Polyimide
Lead Diameter	0.75 mm
Implantable Length	Up to 45 mm
Electrode Contact Shape	Elliptical
Channel Count	32

Left: *Acute rDBSA probe*
Inset: *Detail view of rDBSA tip, showing stimulation sites*

The **rDBSA (research-Deep Brain Stimulation Array)** is the research-grade version of an innovative clinical DBS technology developed by NeuroNexus.

- **Acute or Chronic** – The rDBSA is available in both acute and chronic versions.
- **High Resolution** – Our 32-channel design enables precise, selective, and tunable microstimulation of deep brain structures.
- **Precise** – With more flexibility in microelectrode positioning, current delivery and stimulation programming can be more selective.

6 Accessories and Services

dDrive

CHRONIC MICRODRIVE

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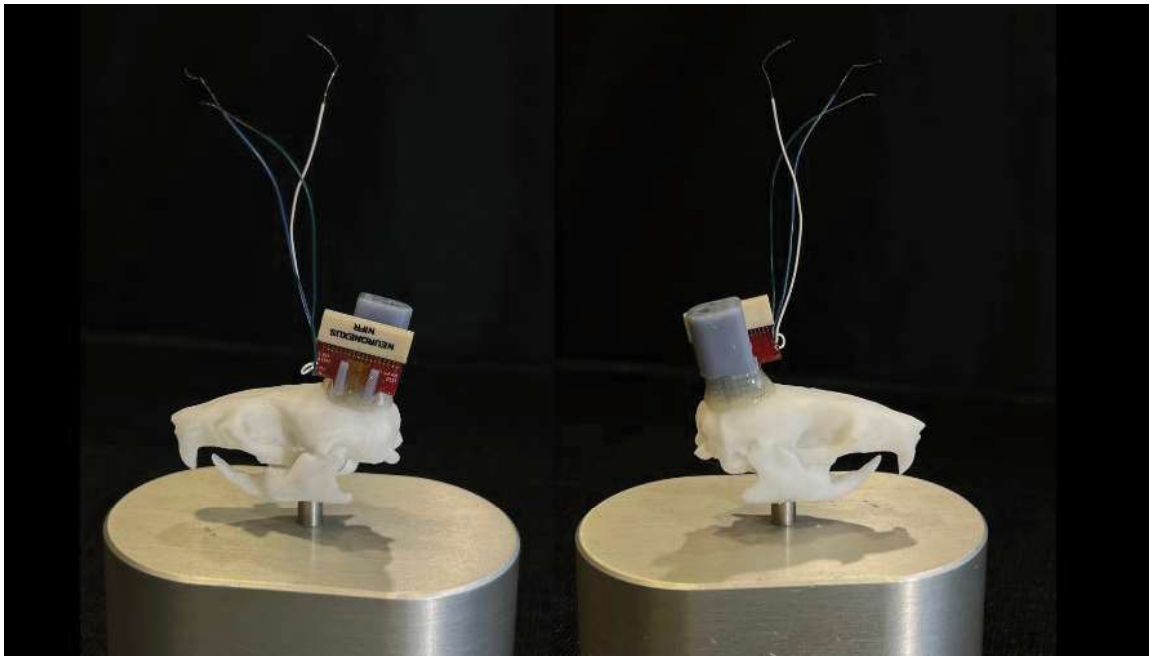


Light, compact, and inexpensive, the **dDrive** chronic microdrive enables precise probe movement in freely behaving animals, and can improve experiment longevity.

- **250 µm/turn** – Carefully target brain layers with the dDrive's high accuracy.
- **Reduced height and smaller footprint**– The dDrive comes in different sizes for different animal models. Minimize strain on a mouse with the dDrive-2.5, or size up to the dDrive-10 for larger brains and animals.
- **Lightweight** – The dDrive-2.5 weighs 0.45 g (with cap), while the largest dDrive-10 weighs 0.85 g (with cap).
- **Secure** – All dDrive models are designed with coarse knurl features for greatly improved adhesion to the skull and stability with cement or epoxy.
- **Highly compatible** – Designed to work with NeuroNexus electrodes and connector packages up to 64 channels.
- **Simplified implant** – Insertion tool is now in-line with electrode axis – no stereotaxic offset necessary!
- Ask for a demo video today!

MICRODRIVE OPTIONS

NeuroNexus offers different kinds of microdrives for different applications:

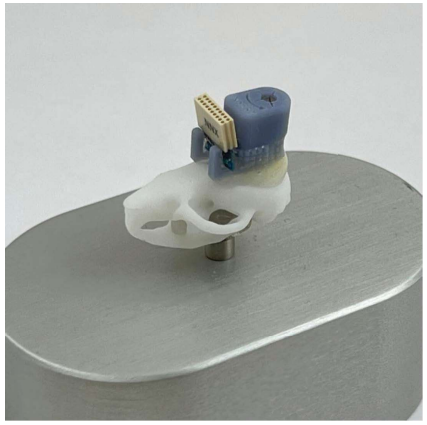
The **dDrive-2.5** is our smallest microdrive, optimized for applications where an exceptionally small and lightweight solution is needed.

The **dDrive-5.0 and dDrive-7.5** suit the widest variety of applications, and the **dDrive-10**, with its extended drive range, is best suited to larger animal models.

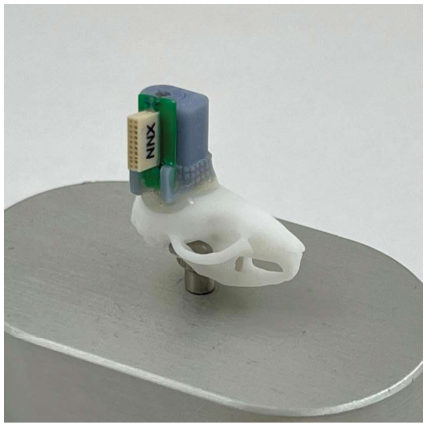
Multiple options for connector orientation allows for more flexibility on microdrive placement.

Optogenetics-compatible – The **oDrive** combines chronic, freely behaving microdrive implants with optogenetics.

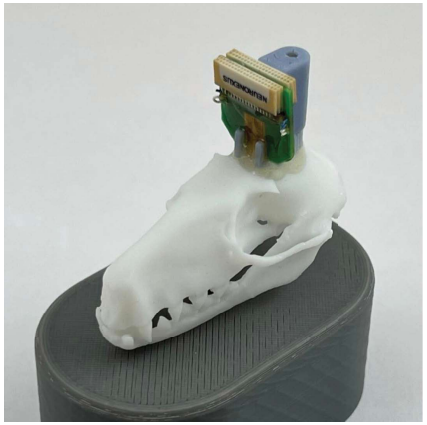
dDRIVE CONFIGURATIONS



connector package: H16_21mm



connector package: HC16_21mm



connector package: H64LP_30mm

connector package: MRH32_21mm

SPECIFICATIONS

dDrive-2.5:	
Drive Range	2.5 mm
Height	8.9 mm
Weight	0.45 g
oDrive-5.0:	
Drive Range	5.0 mm
Height	11.4 mm
Weight	0.55 g
oDrive-7.5:	
Drive Range	7.5 mm
Height	13.9 mm
Weight	0.70 g
oDrive-10:	
Drive Range	10 mm
Height	16.4 mm
Weight	0.85 g
All models:	
Width x Length	5.7 x 8.25 (mm)
Drive Resolution	250 µm/turn
Drive Mechanism	Screw base
Optical Termination	1.25 mm ferrule
Fiber Options	50/62.5 µm, 0.22 50/70 µm, 0.22* 105/125 µm, 0.22 105/125 µm, 0.66

**Coupling loss of -3.2 dB/ junction, measured with 105 µm patch cable*

oDrive

OPTOGENETICS-ENABLED MICRODRIVE

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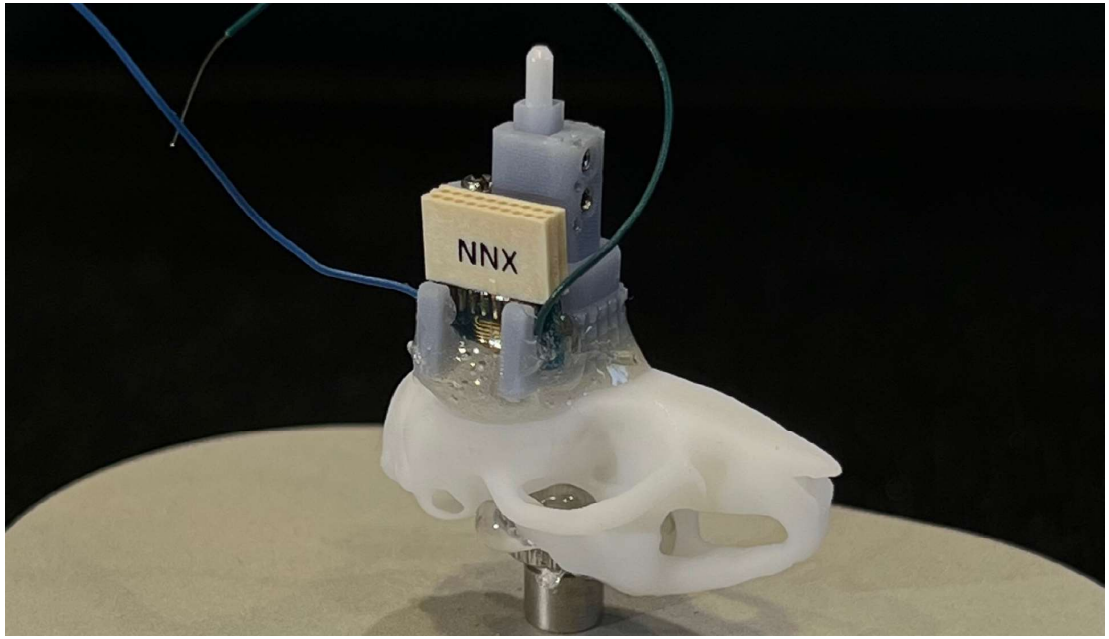

The **oDrive** is the optogenetics-enabled version of the compact and accurate dDrive chronic microdrive.

- **250 µm/turn** – Carefully target brain layers with the oDrive's high accuracy.
- **Right-sized for different animal models** – The oDrive comes in four sizes for different animal models. Minimize strain on a small animals or rodents with the oDrive-2.5, or size up to the oDrive-10 for larger brains and animals.
- **Lightweight** – The smallest oDrive-2.5 weighs 0.55 g, while the oDrive-10 weighs 0.95 g.
- **Fiber options** – Select from four different optical fiber options to match your needs. See specifications for more information.
- **Simplified implant** – NeuroNexus worked closely with labs to develop a low-risk implant procedure. Ask us for a demonstration video!

SPECIFICATIONS

oDrive-2.5:	
Drive Range	2.5 mm
Height	11.9 mm
Weight	0.55 g
oDrive-5.0:	
Drive Range	5.0 mm
Height	16.9 mm
Weight	0.65 g
oDrive-7.5:	
Drive Range	7.5 mm
Height	21.9 mm
Weight	0.80 g
oDrive-10:	
Drive Range	10 mm
Height	26.9 mm
Weight	0.95 g
All models:	
Width x Length	6.2 x 9.75 (mm)
Drive Resolution	250 µm/turn
Drive Mechanism	Screw base
Optical Termination	1.25 mm ferrule
Fiber Options	50/62.5 µm, 0.22 50/70 µm, 0.22* 105/125 µm, 0.22 105/125 µm, 0.66

**Coupling loss of -3.2 dB/junction, measured with 105 µm patch cable*

pDrive

CHAMBER MICRODRIVE SYSTEM

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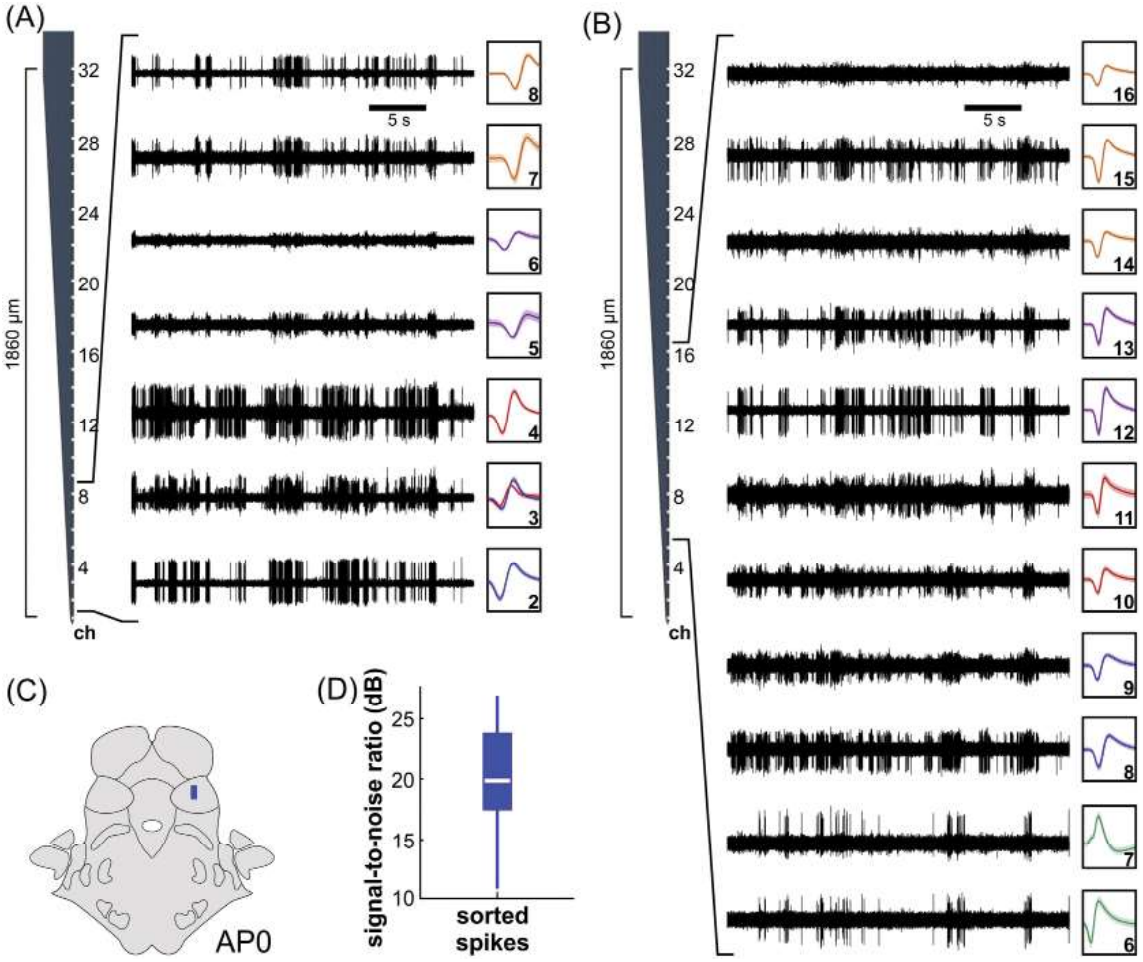
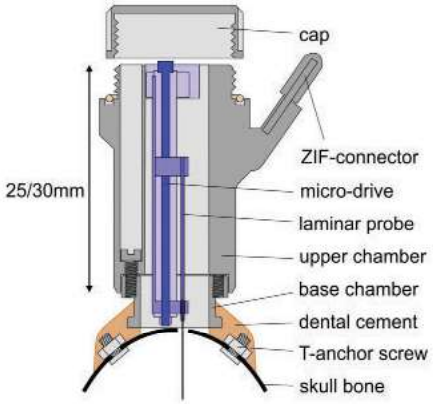


Above: *Chronic recordings obtained from behaving marmosets.*
Pomberger T, Hage SR (2019) Semi-chronic laminar recordings in the brainstem of behaving marmoset monkeys. Journal of Neuroscience Methods 311, 186–192.
Image courtesy of Dr. Steffen Hage of the Hage Lab.



The new **pDrive** is a chronically head-mounted microdrive designed to be used in primate prep. Based on the widely used dDrive, the pDrive microdrive can increase the effectiveness and longevity of chronic experiments.

- Compatible with Vector Arrays™ and standard probes
- 7 mm drive range (customizable)
- 150 µm/turn drive resolution (customizable)
- Probe position can be adjusted in 3 axes (x, y, z)
- Multi-drive capable
- Compatible with commercially available recording chambers such as those from Grey-Matter Research

Headstage Adaptors

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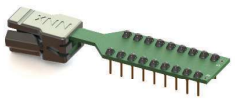
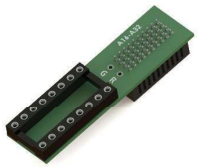



If you have a headstage that does not connect directly to one of our probe packages, you might need a **headstage adaptor.** NeuroNexus offers a range of adaptors, listed on our website. If you cannot find an adaptor to meet your needs, custom adaptors can be fabricated.

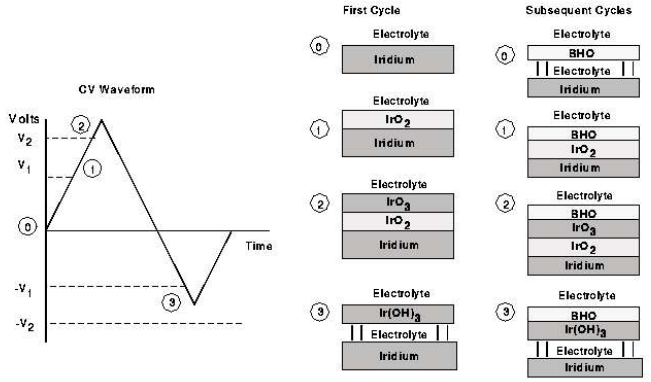
NOTE: When mapping electrode sites to the headstage with an adaptor, the adaptor map must be taken into consideration. Adaptor maps describe the channel routing through the adaptor.

Activation

Activation is a process which alters the charge capacity and impedance characteristics of a probe with iridium contacts, without affecting biocompatibility:

- Activated iridium increases the amount of charge that can be delivered during stimulation.
- For recording applications, activated iridium sites exhibit lower impedance than non-activated sites.

Our technical note on iridium activation, accessible on the NeuroNexus website, provides an in-depth analysis.



MR Accessories

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MR Accessories utilize trace to no amounts of ferromagnetic material to minimize MRI interference.

CATALOG #	DESCRIPTION
MR-Brainamp-Jumper	Jumper cable between adaptor and BrainAmp. Length can be customized. **NOTE:** Contains nickel-plated material.
MR-BrainAmp-Omnetics16x2	BrainAmp adaptor (32-channel)
MR-Omnetics16-Wire	Mate to Omnetics connector on the probe. Nickel-free material. Cable length ≈ 10" (254 mm)
MR-Omnetics16-Jumper	Jumper cable between adaptor and NeuroNexus probe. Nickel-free material.

Consulting

Adapting to a new technology and technique can involve steep learning curves.

NeuroNexus staff engineers and scientists bring together decades of pioneering experience in neuroscience and microfabrication. Our practical expertise can reduce your ramp-up time and allow you to focus on your research. We work with you side-by-side to plan out your experiment and come up with a strategy to minimize known and anticipated issues.

Surgical techniques often have a very significant impact on the outcome of an experiment, especially in chronic applications. We can help train your group and get you up and running quickly.

NeuroNexus can provide consultation on the following:

- Perform surgery and implant electrodes for you on-site
- Assist with the design of the experiment
- Assist with pre-surgery planning
- Training in surgical techniques necessary to maximize the performance of your probe
- Assist with data analysis

Training Kits

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Mock probe assemblies are available for training purposes. These assemblies are designed for insertion practice or mock surgeries, and are not functional. The mock probe assemblies do not include actual PCBs or connectors.

New users looking to move up from training kits may consider trying B-Stock probes, which are irregular probes and are offered at discounted prices.

7 Instrumentation

Multi-Probe Manipulator (MPM)

MULTI-PROBE SIMULTANEOUS RECORDING

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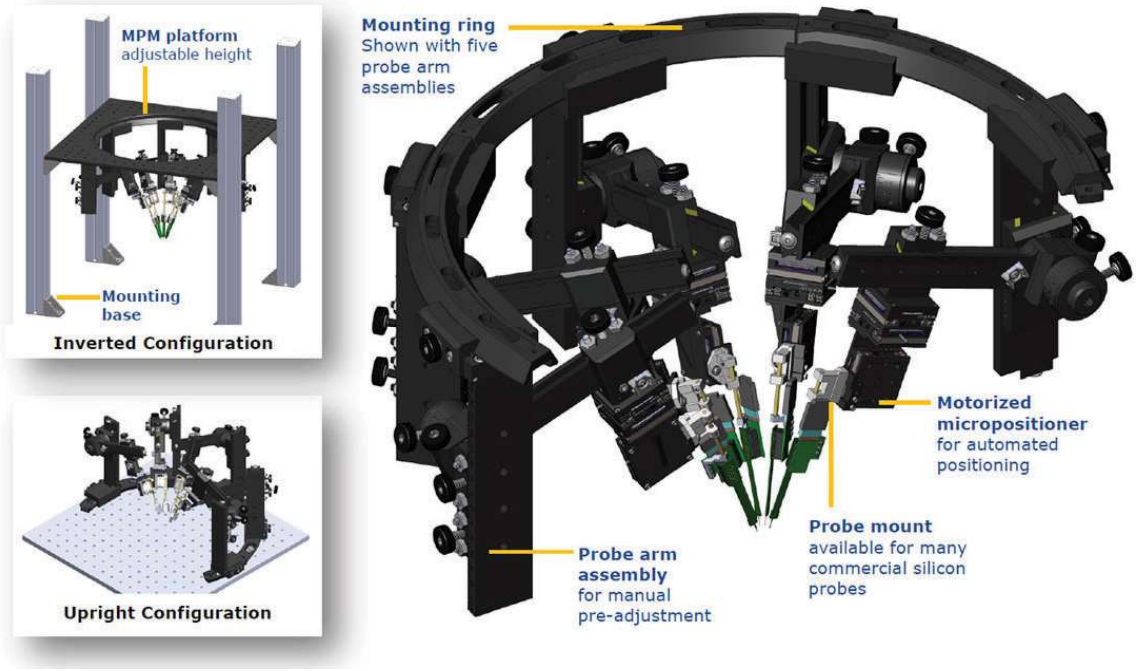

Master multiple simultaneous recordings with the New Scale **Multi-Probe Manipulator (MPM),** the only micromanipulator designed specifically for positioning the newest silicon probes used in acute recordings.

- **Compact size** – Independently position multiple probes in a small space
- **Get creative with your experiments** – Isolate neurons with one probe, record LFPs with a second probe, and stimulate with third, all while recording mapped signals with the SmartBox Pro data acquisition system. The sky's the limit!
- **Easily control 5 or more probes** – Up to 24 axes of automated motion (3 axes/micropositioner), all controlled by a single computer application.
- **Gross manual + fine automated control** – four-axis arms enable quick setup, and three-axis automated micromanipulators adjust probe position with sub-micrometer precision.
- **Flexible device compatibility** – Use any combination of probes, tetrodes, optical fi bers, and waveguides to take your experiment to the next level.

Images courtesy of New Scale Technologies

SPECIFICATIONS

Travel Range	15 mm/axis
Payload	100 g (recommended), 200 g (maximum)
Speed	4 mm/s
Resolution	0.5 µm
Bi-directional Repeatability	< 5 µm
Accuracy	< 20 µm
Dimensions	32 mm x 32 mm x 11 mm with each embedded controller

AlphaComm-I

MOTORIZED COMMUTATOR

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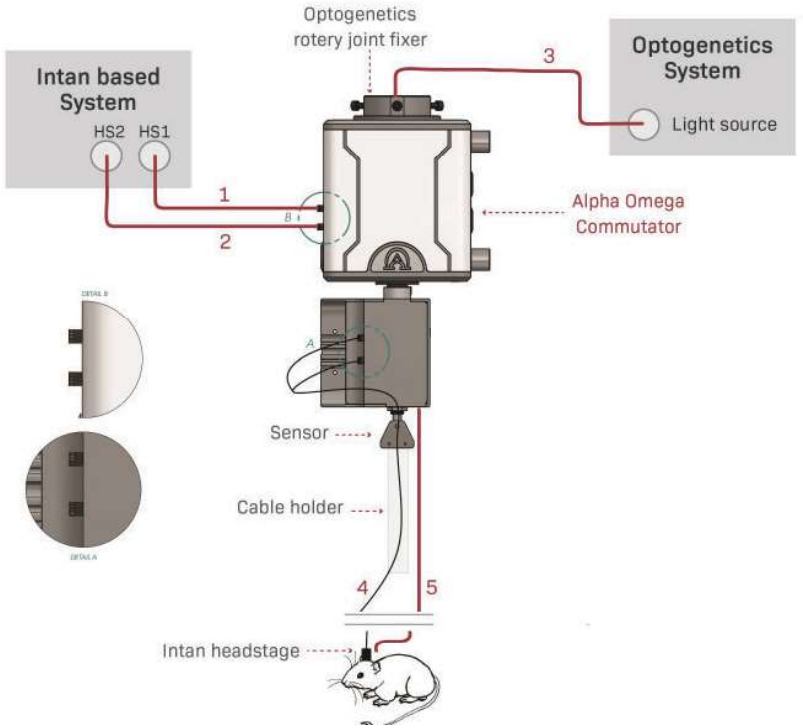

The Alpha Omega **AlphaComm-I** is a motorized slip ring commutator that facilitates smooth tethering to research animals. It supports both neural recording and stimulation. The commutator actively tracks the rotation of the headstage cable and compensates, eliminating turn-induced torques on the research subject.

Key Features:

- Supports 16-256 channels
- High resolution sensing
- Controllable commutator speed and sensitivity
- Compatibility with Intan Headstages
- Compatibility with optogenetics up to 4 fibers
- Compatibility with liquid tubes
- Allows electrical stimulation on all the channels
- Additional 10 wires (general purpose)
- Compatibility with variety of arena sizes and shapes
- Allows video tracking/recording

Images courtesy of Alpha Omega

NeuralGlider

NEURAL IMPLANT INSERTION SYSTEM

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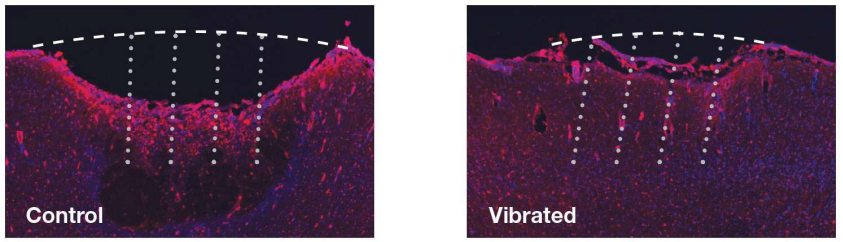
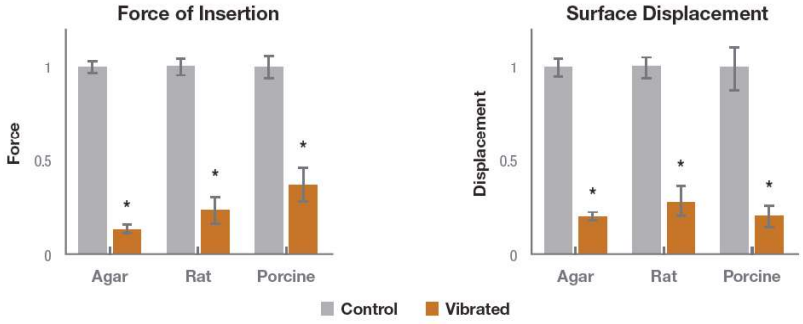
Images courtesy of Actuated Medical

The **NeuralGlider**-Cortical System from Actuated Medical maximizes the quality of chronic neural implant recordings in pre-clinical neuroscience studies.

- **Reduced insertion force** - Micron-scale, ultrasonic vibration during insertion reduces the force required to penetrate the brain surface
- **Accurate** - Reduced insertion force facilitates slow (0.1 mm/s or slower), accurate array insertions while minimizing dimpling or tissue displacement
- **Preserve tissue integrity** - Slow and accurate insertions with minimal tissue displacement can result in better signal-to-noise ratio compared to conventional insertions.
- **Integrated software** controls insertion velocity and depth



Above: *Compared to a standard control insertion (left), NeuralGlider reduced cortical surface damage and blood brain barrier leakage (IgG staining, red) at the insertion site (right). Images show 20µm rat cortical sections, 2 weeks after implantation. Source: Actuated Medical.*



Above: *Ultrasonic vibration of microwire arrays during insertions with NeuralGlider significantly reduced penetration force in an agar brain model, and ex vivo rat and porcine cortex (reductions in force = 86.3%, 76.5% and 62.7%, respectively). The reduction of force correlates to a 70 – 80% reduction in cortical surface displacement/dimple during array insertion, for all tissues. Source: Actuated Medical.*

Insertion Tools

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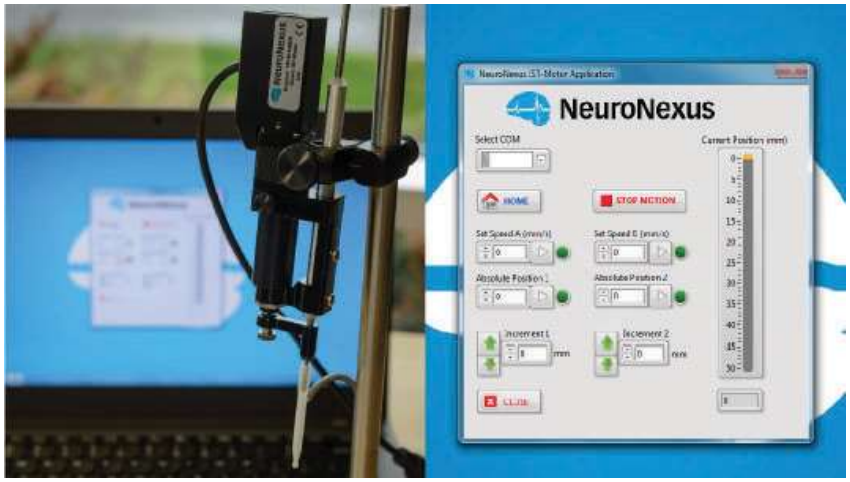
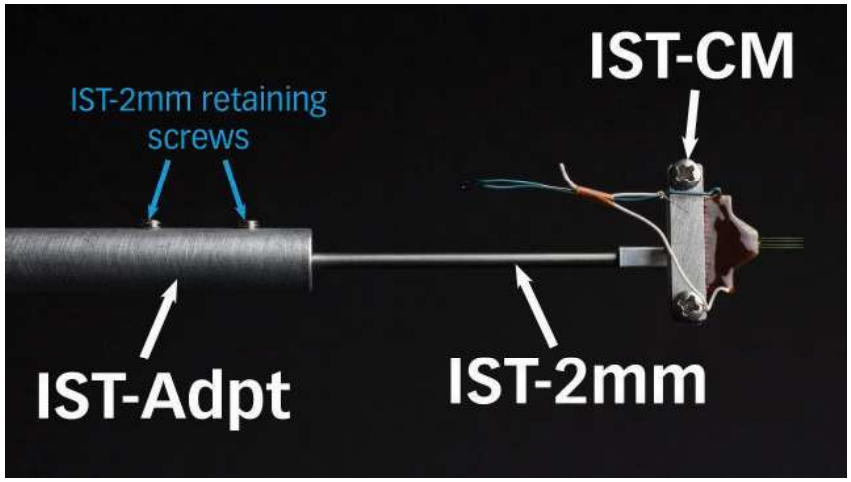
AUTOMATIC INSERTION TOOLS



The IST-Motor is a computer-controlled insertion tool developed to allow precise, micron-accurate probe insertions. The IST-Motor is designed to interface directly with standard stereotaxic frames. To complement the macro-scale adjustments of a stereotaxic frame, the IST-Motor is capable of 50 mm of movement. Insertion speed is adjustable between 0.22 µm/s – 8 mm/s, and insertion can be performed by absolute position or in increments as small as 0.05 µm.

MANUAL INSERTION TOOLS



Manual insertion tools attach to the probe package and terminate with a 2 mm rod. To attach the 2 mm rod to a standard Kopf 7.9 mm stereotactic frame, you will need an adaptor (IST-ADPT). Custom rods with a diameter less than 8 mm are also available.

ORDERING

IST-ADPT	Adaptor to connect 2 mm mounting rod to 7.9 mm stereotactic frame
IST-CM	Insertion tool for CM and Zif-Clip packages
IST-CM_Kit	Includes IST-CM and IST-ADPT

All-Angle Manipulator

FULLY ARTICULATED POSITIONING ARM

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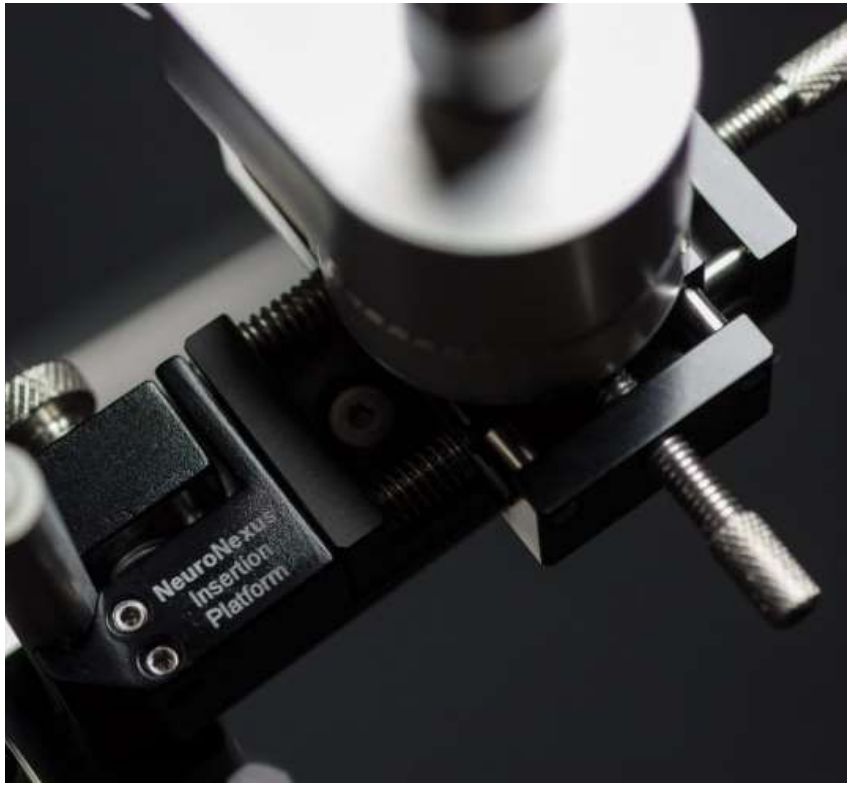

Quickly and easily position a probe for implant with the NeuroNexus **All-Angle Manipulator,** a fully articulated positioning arm with 90° pivotable and 360° rotatable ends, and a 360° rotatable elbow.

- **Simple operation** – One locking knob loosens the arm, and the entire device can be operated quickly and precisely with two hands. Tighten the knob to lock the arm in place.
- **Two-axis fine tuning** – The Insertion Platform allows fine adjustment of the probe position once the arm has been set.
- **Kopf® compatibility** – a Kopf® adaptor enables easy mounting to a Kopf® stereotaxic frame.

SPECIFICATIONS

Total Length: 245 mm

Insertion Platform: ± 5 mm in two axes

8 Custom Design

Designing Your Own Probe

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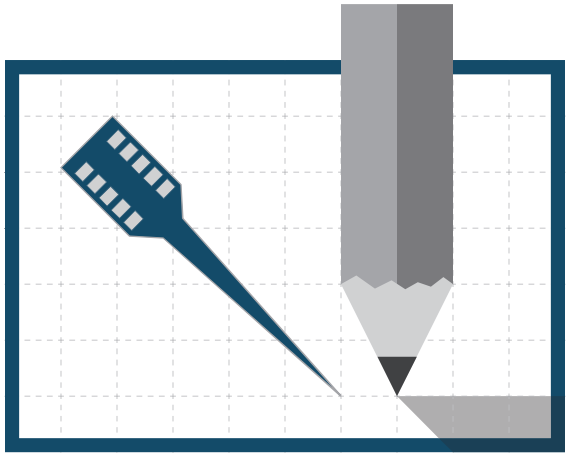

NeuroNexus offers **custom design services** that provide unique access to infinite possibilities within our design space. Almost any feature of an electrode array can be tailored to suit your application. Custom adaptors and cables can be fabricated to match almost any experimental setup.

- Each custom probe includes:
- Consultation with our engineering team to validate feasibility of your proposed design
- Translation of your design into a CAD layout
- Formal design review with our technical team
- State-of-the-art microfabrication of your design
- Packaging and testing of your fabricated probes

Custom Probe Design Services

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There are three main time-consuming elements in the Custom Design process: time to get into the design queue, time for fabrication, and time for assembly. The first element is usually the rate-limiting step in the process since there is not always room to put a new design onto an upcoming mask set. Since we run new mask sets only once every few months, getting a priority position on an upcoming mask can make months-worth of difference in delivery time. Our Custom Design Service has tiered pricing allowing us to give customers more options for access to leading edge silicon microelectrode technology, and at lower price points.

	16 Channel	32 Channel	64 Channel	Vector Array	Matrix Array
MINIMUM ORDER	**10 probes**	**10 probes**	**5 probes**	**5 probes**	**5 probes**

Unit pricing for custom design requests are dependant on channel count, feature spacing, packaging, shank length and site material.

Custom Design Process

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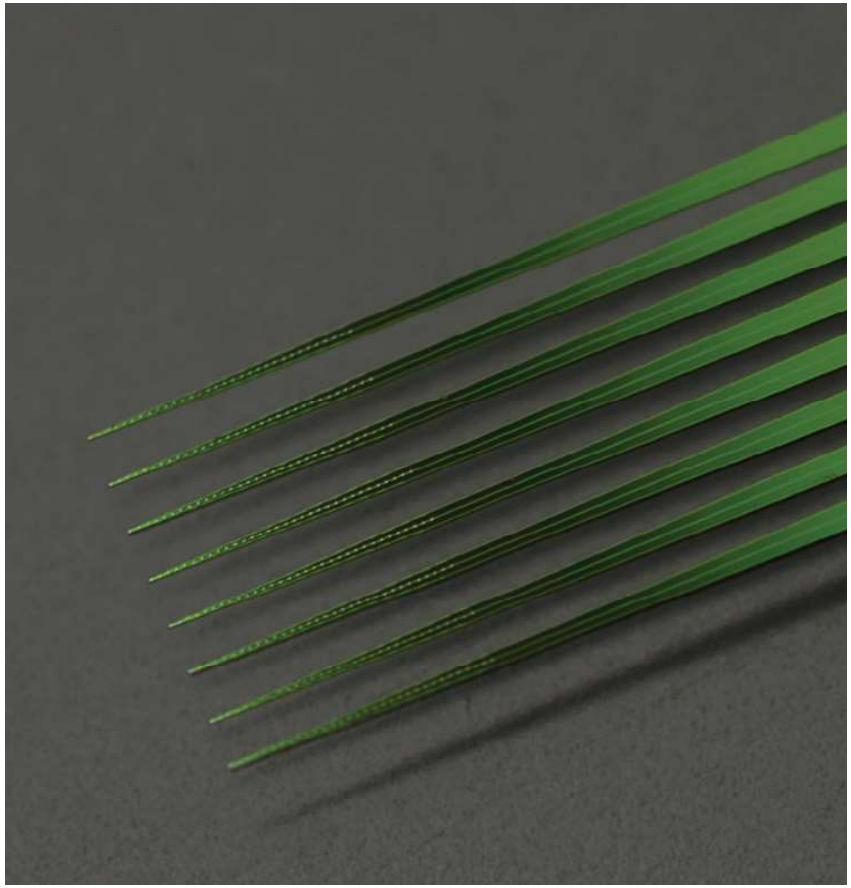
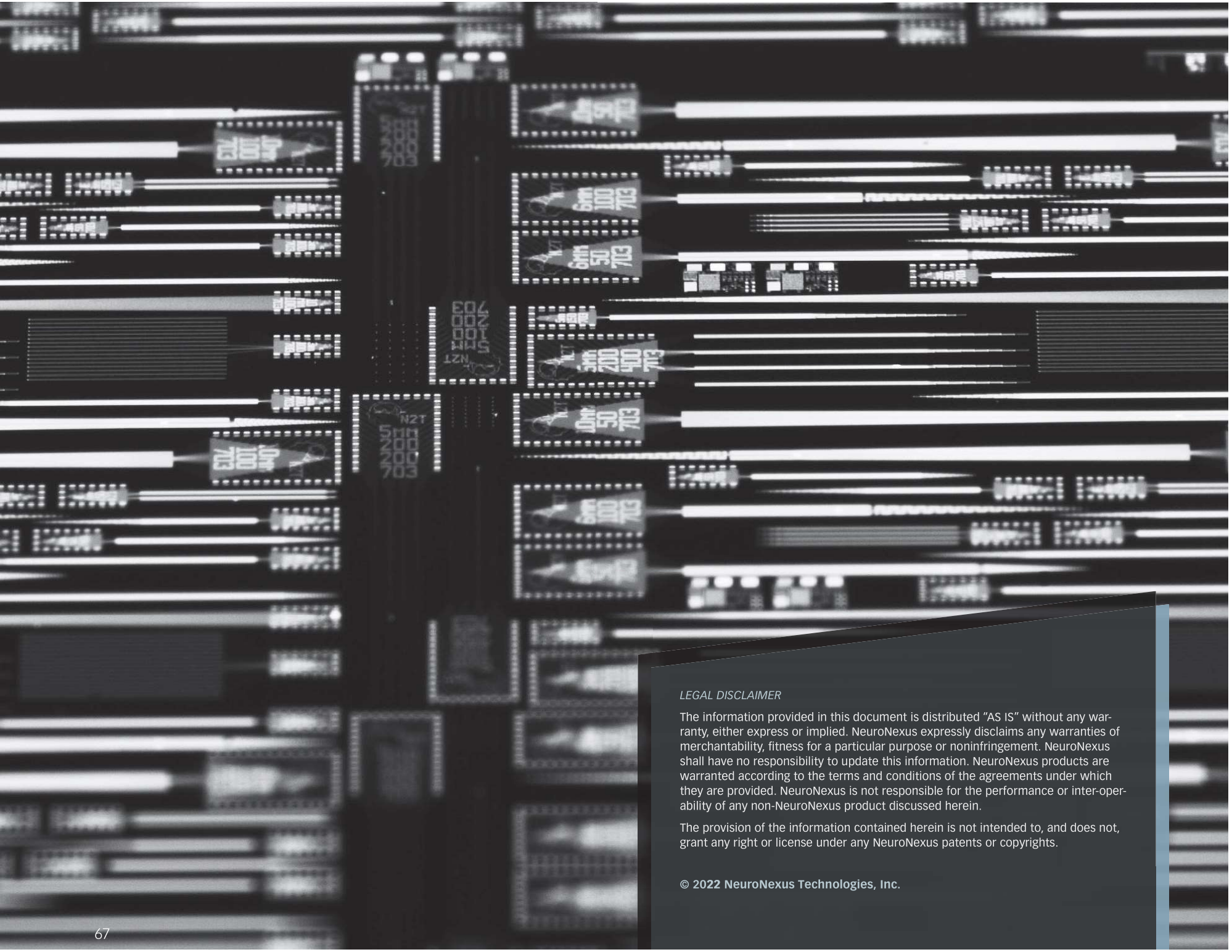
NeuroNexus probes are manufactured using state-of-the-art design, microfabrication and packaging techniques. Design is accomplished using a semiconductor computer-aided design (CAD) tool that results in a multi-layer mask set. These photolithographic masks are used in the fabrication process to transfer patterns of the probe features onto thin-films that have been deposited on a silicon wafer.

Thin-film fabrication is a batch process that permits us to fabricate a variety of probe designs simultaneously on a silicon wafer. NeuroNexus offers a Custom Design Service where customer-submitted designs can be fabricated on the same wafer as our standard catalog designs, and then packaged for use per the customer's specs.

RIGHT: Buz256 probe





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